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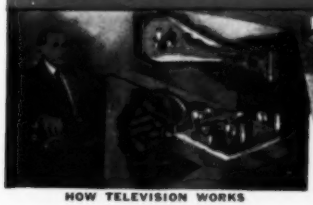

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ROGER BURLINGAME ("Pulling Hats out of Rabbits," page 52) was headed for an engineering career when he found that his talent was primarily that of a writer. Two of his books, "March of the Iron Men" and "Engines of Democracy," tell of the social effects of invention. His latest, "Whittling Boy," is a biography of Eli Whitney, father of mass production.

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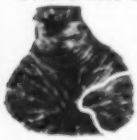

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Nearly every neighborhood offers opportunities for a good part time Radio Technician to make extra money fixing Radio sets. I give you special training to show you how to start cashing in on these opportunities early. You get Radio parts and instructions for building test equipment, for conducting experiments which give you valuable practical experience. You also get a modern Professional Radio Servicing Instrument. My 50-50 method—half working with Radio parts, half studying my lesson texts—makes learning Radio at home interesting, fascinating, practical.

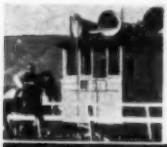
Find Out How N. R. I. Teaches Radio and Television

Act today. Mail coupon now for 64-page Book. It's FREE. It points out Radio's spare time and full time opportunities and those coming in Television; tells about my Course in Radio and Television; shows more than 100 letters from men I trained, telling what they are doing and earning. Find out what Radio offers you. Mail coupon in envelope or paste on penny postcard—NOW.

J. E. SMITH, President
Dept. IMP3
National Radio Institute
Washington, D. C.

Broadcasting Stations employ N. R. I. trained Radio Technicians as operators, installation, maintenance men and in other capacities and pay well.

Set Servicing pays many N. R. I. trained Radio Technicians $30, $40, $50, a week. Others hold their regular jobs and make $5 to $10 extra a week in spare time.



Loudspeaker System building, installing, servicing and operating is another growing field for N. R. I. trained Radio Technicians.

I Trained These Men

$10 a Week in Spare Time

"I repaired some Radio sets when I was on my tenth lesson. I really don't see how you can give so much for such a small amount of money. I made $600 in a year and a half, and I have made an average of $10 a week—just spare time." JOHN JERRY, 1729 Penn St., Denver, Colorado.

Makes $50 a Week

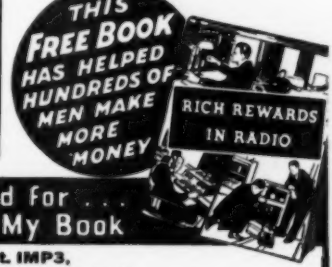
"I am making around $50 a week after all expenses are paid, and I am getting all the Radio work I can take care of, thanks to N. R. I." H. W. SPANGLER, 1261½ S. Gay St., Knoxville, Tenn.

Operates Public Address System

"I have a position with the Los Angeles Civil Service operating the Public Address System in the City Hall Council. My salary is $170 a month." R. H. ROOD, R. 130, City Hall, Los Angeles, Calif.

Extra Pay in Army, Navy, Too

Every man likely to go into military service, every soldier, sailor, marine, should mail the Coupon Now! Learning Radio helps men get extra rank, extra prestige, more interesting duty at pay up to 6 times a private's base pay. Also prepares for good Radio jobs after service ends. IT'S SMART TO TRAIN FOR RADIO NOW!



This Coupon is Good for . . . One FREE Copy of My Book

J. E. SMITH, President, Dept. IMP3,
National Radio Institute, Washington, D. C.

Mail me FREE, without obligation, your 64-page book "Rich Rewards in Radio." (No salesman will call. Write plainly.)

NAME.....AGE.....

ADDRESS.....

CITY.....STATE.....

There's a Preparedness Problem *in your home too!*

THIS Underwood Champion Portable is particularly smart in its modern design and finish . . . and comes in a trim lightweight carrying case. Just what a youngster needs for homework—what the whole family needs for *all* writing tasks. And it's made by the makers of all the *big* Underwoods of business. Note the 15 Big Underwood features. Don't be satisfied with an ordinary portable—insist upon a *complete* Underwood.

See your nearest UNDERWOOD DEALER or write direct for full information.

An Underwood Portable will help prepare youngsters for graduation now . . . and for business later.

The complete PORTABLE with fifteen features of the famous Big UNDERWOOD of business

1. *Champion Keyboard, 84 Characters.* **2.** *Left Side Back-Spacer.* **3.** *Left and Right Carriage Release.* **4.** *Right Margin Stop with Warning Bell.* **5.** *Paper Release Lever.* **6.** *Black and Red Ribbon.* **7.** *Single, Double and Triple Line Spacer.* **8.** *Paper Bail.* **9.** *Variable Line Spacer.* **10.** *Right and Left Shift Keys.* **11.** *Sealed Action Frame.* **12.** *Touch Tuning.* **13.** *Paper Centering Scale.* **14.** *Margin Release.* **15.** *Keyboard Tabulator.*

UNDERWOOD ELLIOTT FISHER COMPANY
One Park Avenue, New York, N. Y.
Sales and Service Everywhere

Underwood
Portable Typewriter

Coming Next Month—

BOMBERS CAN'T LAND in cowpastures—at least, not as a regular practice. And with our mushroom growth in military and civil aviation, the question naturally arises: Can America build enough air fields to accommodate these flocks of planes? P. O'Malley gives the answer in a timely article that throws a new sidelight on the problems accompanying air power.

SURGICAL CARPENTRY—the mending of broken bones and treatment of physical ills by the use of "body hardware"—gets new impetus from the discovery of an alloy that can be left permanently embedded in living bone. Read about this revolutionary medical development and the surgical miracles now made possible by its use.

WHERE WILL WE GET the officers to man our rapidly expanding Navy? Answering that question is the big job that has been handed to our excellent Naval Academy. "Annapolis Speeds Up" tells how the training of our future admirals has been geared to the tempo of growing sea power. Pictures take you through the day with a middy and illustrate some of the traditions of the school.

CHRISTMAS IS COMING! Why not do something different this year in the way of yuletide decorations to make your house say "Merry Christmas" to every passer-by? You can get some good ideas from an article packed full of good suggestions and illustrated with drawings that will make you hear sleighbells and smell plum pudding!

LIGHTWEIGHT CHAMPION of the metals is magnesium—only three fourths as heavy as aluminum and an essential ingredient in airplane engines and many other defense products. Since it can be extracted from sea water, the original source of supply is not likely to be cut off. You'll want to know about this useful metal and the part it plays in industry in war and peace.

HANDSAWS are among the most common of hand tools. You've been using them since you made your first toy boat, but unless you're a master craftsman there probably are lots of things you don't know about them. In "Handsaws and How to Use Them," Edwin M. Love covers the field pretty completely, describing the different kinds and giving some useful hints on their use and care. Here's one you'll want to file away!

YOU'RE like a million other men today—you're facing a big question. The last ten years turned business topsy-turvy and now the rebuilding period stares you in the face. The Defense program, new world conditions and the business pick-up offer new opportunities, but also new problems.

Where you are "going from here" is a question you want answered right if you expect to get ahead—progress—grow instead of standing still.

Are the things that are happening today going to help or hinder you—what will they mean in your pay check? Where will they put you five—ten—twenty years from now?

How can you take full advantage of this period of opportunity? We believe you will find the answer here—a suggestion the soundness of which can be proven to you as it has been to thousands of other men.

The whole trend today—legislation—spirit—action—is upward, up to higher business records than ever before. New factories, enlarged plants, new products are calling for more men.

Business organizations are rebuilding—organizing and expanding for the new conditions. Employees are being studied, judged as to how they fit in the expanding program, especially into the key and supervisory jobs which demand most and pay best. This spells real opportunity for the man who can meet the test—but heaven help the man who still tries to meet today's problems from yesterday's standpoint! Out of the multitude still jobless there are sure to be many frantically eager to prove him wrong and take his place.

Some Men Have Found the Answer

Seeing these signs, many aggressive men and women are quietly training at home—are wisely building themselves for more efficient service to their employers. They are studying with us because our training courses are as fresh, vital and up-to-the-minute as the problems that face you today.

You naturally ask, "Has your training helped men withstand conditions of the last few years?"

Our answer is to point to a file of letters from thousands of our students reporting pay raises and promotions while business was at its lowest ebb—together with a myriad of others telling of greater success during these recent months of recovery.

Convincing evidence is ready for your investigation. We have assembled much of it in a booklet that is yours for the asking, along with a new and vitally interesting pamphlet on your business field.

This is a serious study of the possibilities and opportunities in that field. It is certain to contain an answer to vital questions bothering you today about your own work and earning power.

Send for these booklets—coupon brings them free. Be sure to check the LaSalle training that interests you most. We will tell you also how you can meet and take fullest advantage of today's situation. No cost or obligation—so why not mail the coupon now?

LASALLE Extension University

A Correspondence Institution

Dept. 1183-R
CHICAGO

Please send me—without cost or obligation—full information about how I can, through your training, equip myself for the new problems and opportunities in the business field I have checked.

☐ Higher Accountancy	☐ Business Management	☐ Business English
☐ Law: Degree of LL.B.	☐ Traffic Management	☐ Salesmanship
☐ Industrial Management	☐ Business Correspondence	☐ Commercial Law

Name .....

Position ..... *Age* .....

Address .....

From the News Editor's Desk

IF A SHORTAGE DEVELOPS IN NAILS, why not build your house of strong, weatherproof plywood, glued together? And if those gleaming chromium bathroom and kitchen gadgets become unobtainable, why not try wood? War shortages of metals and plastics are likely to force even more radical architectural changes than these, according to Albert C. Schweizer, head of the New York University School of Architecture. A labor scarcity has already made the prefabricated house almost commonplace, Schweizer points out, and the coming shortage of metals will bring back wood, especially in plywood and plastic form, as the basic building material.

PERFECT PERFORMANCE of a Boeing Flying Fortress flying at 35,000 feet was effected recently in the trial of a newly developed pressure harness for the ignition system. The unit was designed by Carl Swanson, research engineer for Northwest Airlines, and is already used on all Northwest Airlines planes. The device eliminates corrosion, contamination, and moisture through the use of chemically treated, dehydrated air, pumped under pressure through the unit. Sea-level conditions may be maintained, and there are no longer voltage leaks at high altitudes.

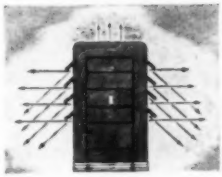
VERY SHORT SOUND WAVES with a frequency of 9,300 cycles a second are produced at the University of California to kill bacteria and other microörganisms. Professor A. P. Krueger has developed for the purpose a nickel tube within a magnetic field, activated by electrical impulses. Alternate pulls of the magnets elongate and contract the tube, the resulting oscillating motion producing sound waves which destroy bacteria and viruses.

ONE OF THE NEW SULFA DRUGS, sulfadiazine, sprayed directly onto burns, healed 114 of 115 badly burned patients admitted recently at Johns Hopkins Hospital, Baltimore. Surgeons stated that burned areas "healed more rapidly than with any form of treatment previously used at the hospital." The method is so revolutionary that it may eliminate the need for skin grafting and plastic surgery to remove scars and correct deformities. The drug had a toxic effect on only one patient, a terribly burned four-year-old boy who died 48 hours after admission. Only two patients showed evidence of infection. The sprayed drug forms a thin, transparent, rough and pliable scab, through which the surgeon watches the healing of the burn and the growth of new skin tissues. Exercise of the burned parts is encouraged, thereby preventing the skin from shrinking and forming disfiguring scars. Dr. Kenneth L. Pickrell, of the hospital's staff, reports that the new treatment is now routine.

Enjoy modern TRIPLE-ACTION HEAT IN YOUR STOVE-HEATED HOME!

Only SUPERFEX Oil Heater has shutters directing heat DOWN to warm the floor. Radiates and circulates heat, too!

PATENTED SHUTTERS DIRECT RADIANT HEAT!



Superfex shutters *direct* cozy, sun-like radiant heat out and downward, warming the floor. And—Superfex circulates warm air throughout the rooms. No other heater gives you the triple comfort advantages of directed, radiant and circulated heat!

ECONOMICAL TO BUY AND TO OPERATE!

Models and prices for every budget. . . Low operating cost, too—both Superfex and Ivanhoe Heaters even burn cheap, high-heat No. 2 oil. Superfex can be fully automatic, if you wish—with thermostat control and simple outside storage tank connection for piping in fuel. Low down payment—easy terms. Send the coupon today!

OTHER STYLES—Superfex and Ivanhoe models available for work-shops, stores, etc. 3-speed blowers available on most models, where heating additional rooms is a difficult problem.

SUPERFEX and IVANHOE OIL HEATERS

The Mark of Quality

PRODUCTS OF PERFECTION STOVE COMPANY

TRADE IN YOUR OLD STOVE • BALANCE EASY TERMS!

SEND FOR FREE, BEAUTIFULLY ILLUSTRATED BOOKLETS!

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7323-B Platt Ave. • Cleveland, O.

Please send me the new, illustrated booklets describing the many models of Superfex and Ivanhoe Oil Heaters.

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Readers Say:

Surfboard from P.S.M. Plans Takes New Sport to Tampa

THE most fun I have gotten out of P.S.M. was the building of a surfboard from the plans in the June 1939 issue. I reordered the issue and made the board last spring, and enjoyed it all summer as you can see from the picture taken at the Sulphur Springs Pool where I worked. Although we have no large surf here to ride, we can enjoy paddling a board in the still waters of the springs, river, and lakes around here. So far as I know, I am the only one in Tampa who has a surfboard, but we are going to build several more. I am a member of Tampa's Red Cross Lifesaving Service, and we are now able to include surfboard work in our lifesaving courses. I would like for you to publish this picture in your magazine to let people know that there are surfboard enthusiasts down here, too.—R. G., Tampa, Fla.

How Can You Keep Worms Alive Between Fishing Trips?

Maybe one of your readers could help a fellow subscriber in distress. I am an ardent fishing fan, and with all these night crawlers around I have difficulty in keeping them from one fishing trip to the next (which is usually every week-end). I was wondering if a fellow Izaak Walton had an idea for keeping the worms alive and firm for a length of time. Also how to feed those wiggly varmints.—A. K., Chicago, Ill.

Those Philosophers Needed a Little Arithmetic

JUST happened on J. D. G.'s renovated old brain fogger concerning the mathematical impossibility of a moving object overtaking another moving object going only half as fast but taking a head start. It is great stuff until it runs up against the time factor and then it goes "pop" like a rubber balloon hitting the end of a cigarette. Suppose the auto does 30 m.p.h. and the bike 15 with a 100-yard head start. At the end of 20 seconds the bike will have covered 146.6 yards, which with the 100 yards handicap will put it at 246.6 yards from the starting line. But the car will have covered 293.2 yards, which will put it 46.6 yards ahead of the bike, no matter what the top-flight philosophers said 2,400 years ago as they sat in the shade, drinking their chilled wine and making cryptic marks in the sand.—P. St. G., Coconut Grove, Fla.

For One Thing, It Gives the Girls a Break

AS A reader of your magazine for the past ten years, I believe I should know what I am talking about when I say it is the best magazine of its kind I have ever seen. Let's keep hearing about Gus and the Model Garage. Since I have to keep two motor vehicles running, I can sure use his hints. To keep the ball rolling in Our Readers Say, here's a chance for your astronomically minded readers: Can any one of you explain, in simple language, just why we have leap years and double leap years? I have been puzzling over this for some time and I wish someone would clear it up for me.—D.A., Colfax, Wash.

He Has One of Reising's .22 Automatic Pistols

IN A recent issue you published an article about Eugene G. Reising's submachine gun manufactured by Harrington & Richardson, in which you mentioned a .22 caliber automatic pistol invented by Reising many years ago. I am the owner of one of those .22 automatics, and it is still a very good gun.—P. P., East Jordan, Mich.

Maybe That's the Way Swing Is Supposed to Sound

RECENTLY I got some new "swing" records for our phonograph, but the diaphragm on the pick-up is loose and it sounds awful. I have a lot of radio junk down in the basement. Couldn't you print some diagrams showing how to make an electric phonograph?—D. C., Milwaukee, Wis.

BABY SCALES TELL VITAL FACTS ABOUT HEALTH

The Auto-Lite "PLUG-CHEK" Tells Vital Facts About Your Motor's Health

Checks Spark Plug Performance 5 Ways!

1. CORRECT HEAT RANGE
2. PROPER INSTALLATION
3. EFFICIENT OPERATION
4. POSITIVE CLEANING
5. ACCURATE REGAPPING

WHAT'S going on in the motor of your car? Why are some cars sluggish, hard to start, slow on pick-up? "Plug-Chek," a new service for car owners, reveals vital facts about engine performance.

The new, scientific Auto-Lite "Plug-Chek" Indicator helps show you whether your spark plugs are operating efficiently—or whether they are wasting gas, robbing your car of power. Check your spark plugs against the Auto-Lite "Plug-Chek" Indicator. The color and condition of the "business end" are revealing indications of what's happening *inside* the motor.

Stop for a "Plug-Chek"—at any Auto-Lite Spark Plug dealer's. Replace faulty plugs with ignition-engineered Auto-Lites. You'll discover they make an amazing difference in engine performance.

THE ELECTRIC AUTO-LITE COMPANY
Toledo, Ohio • *Merchandising Division* • **Sarnia, Ontario**

Auto-Lite Engineers, through countless tests and experiments, have developed the amazing Auto-Lite "Plug-Chek"—a new, money-saving service for motorists.

AUTO-LITE *Ignition Engineered* SPARK PLUGS

SAVE UP TO 50%

FACTORY-TO-YOU

FREE "RED HEAD" BOOSTER AERIAL

WITH THIS CHASSIS (For A Limited Time Only)

Now... YOU CAN'T Miss THOSE THRILLING FOREIGN STATIONS

with the New 1942 MIDWEST SUPER BAND SPREAD CHASSIS!

NOT JUST 3 BANDS
NOT JUST 4 BANDS..
NOT JUST 5 BANDS, BUT...

9 BANDS

(ON SIX DIAL SCALES)

ENJOY 20 TIMES EASIER TUNING...

PUT THIS NEW CHASSIS IN YOUR PRESENT CABINET!

$19.75

COMPLETE CHASSIS

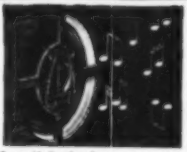
With Speaker, Tubes, Push Button Tuning . . . Magna Tenna Loop Aerial . . . Ready To Plug In and Play

UP TO $50 TRADE-IN

MIDWEST offers many sensational new features this year, including 9 bands and BAND SPREAD TUNING which make Midwest radios 20 times easier to tune—makes them 10 times more sensitive than ordinary radios. And wait until you hear Midwest's Crystal-Clear High Fidelity tone! Here is new vivid realism—here is a rich new clarity of tone. You get the wholesale factory-to-you price when you buy direct from Midwest—you save up to 50%—and you secure so much more in performance and in radio realism. Midwest offers you an amazingly large trade-in allowance for your old radio—on many of the 1942 models shown in the big, FREE, 1942 Midwest catalog.

Enjoy Today's Finest HOME RECORDING

You'll be fascinated by the entertainment you can secure with a Midwest automatic record-playing 8 or 16-tube radio-phonograph. Talk or sing into the studio-type microphone or make a record of your family's voices. Enjoy a full hour of entertainment because up to twelve 10-inch or eleven 12-inch records may be played automatically. Buy your radio the Midwest HOME TRIAL way! Test it in your home for 30 days before you make up your mind! Write today for big, FREE catalog, featuring from 5 to 16 tubes—including Automatic Record-Changing Radio Phonographs; Home-Recorder, etc.—from $12.95 to $212.50.



Acousti-Sonic Louvres with Violin-Type "F" Slot Sounding Board . . . spread the High Fidelity tones scientifically throughout the room . . directing the High Fidelity waves uniformly to the listener's ears.

EASY TERMS

16-TUBE

Model "Y" Console—Superb design, graceful lines, richly finished woods. Size: 39" high, 27" wide, 13" deep.

MIDWEST RADIO CORPORATION
DEPT. 59-B CINCINNATI, OHIO

Readers Say:

Trout Fisherman Wants an Article on Flies

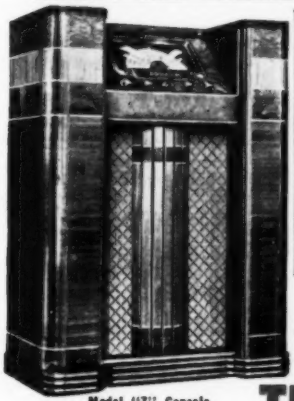
IN THE three years I have read P.S.M., I have not seen more than a few articles about that swell sport, trout fishing. Since you fellows are always digging up information on some subject or other, why not print an article with colored pictures of as many insects, flies, and grubs as you can find that hatch and grow between May and September? In this way you would increase every sportsman's desire to use artificial lures and discourage the yearly slaughter of trout by the "garden hackle" method. Now, don't get me wrong: I have nothing against bait fishing, but I don't like to see fellows go after trout in this manner with the idea of "getting the limit" just so long as they skin over the regulated size, because it isn't the fisherman that fools the fish, it is the live-bait action and the hidden hook. In fishing with wet or dry flies, the fisherman's skill comes into the picture and that is what puts the sport in trout fishing.—R. S., Wharton, N.J.

A Treadle Might Be Better for Radio Cough Eliminator

THAT microphone "cough button" for radio announcers might be improved by imitating the foot treadle used by railroad operators when they want to "talk" to the dispatcher. The bar is about 18 inches long and is placed about an inch off the floor under the desk. When the operator wants to be connected with the dispatcher, he just steps on the treadle. This leaves both hands free for papers or typewriter. Maybe a radio engineer could get a better idea by visiting a local railroad operator and seeing it work.—J. E. K., Grand Junction, Colo.

30 DAYS HOME TRIAL

ON ANY 1942 RADIO IN THIS BIG FREE CATALOG!



Model "Z" Console
You'll like its refreshingly new and beautiful lines. Size: 41" high, 30" wide, 14" deep.

16-TUBES

11-TUBE Model "X" Console
Beauty of line and finish make for distinguished cabinet beauty. Size: 37" high, 24¾" wide, 12" deep.

16-TUBE Model "K" Console
Tilt-front, record-changing, radio-phono. (Available with Home Recorder). Size: 42" high, 28" wide, 16" deep.

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FILL IN COUPON AND MAIL TODAY OR JUST SEND YOUR NAME AND ADDRESS ON 1¢ POSTCARD

MIDWEST (Factory-to-You) RADIOS
MANUFACTURERS OF QUALITY RADIOS SINCE 1920

Midwest Radio Corporation
Cincinnati, Ohio, U. S. A.
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Send me your new FREE Catalog, complete details of your liberal 30-day Trial offer and factory-to-you prices.

Name.....
Address.....
Town.....State.....
User-Agents Make Easy Extra Money. Check here ( ) for details.

GIVE HEATROLA THE EYE BEFORE YOU BUY

any cabinet heater

IT'S THE ORIGINAL CABINET HEATER
THE RECOGNIZED LEADER FOR 20 YEARS

- Big, Beautiful, Modern. A handsome addition to your living room.
- Circulates healthful whole-house warmth. Keeps floors warm.
- Patented Intensi-Fire Air Duct saves fuel. Turns waste into warmth.

THERE IS ONLY *ONE* HEATROLA . . . *ESTATE* BUILDS IT

Estate HEATROLA

Models for OIL, COAL and GAS

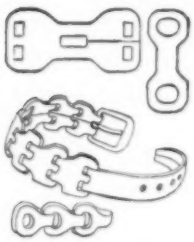
THE ESTATE STOVE CO., HAMILTON, OHIO

"LOOK UP YOUR HEATROLA MAN... HE'LL MAKE THINGS HOT FOR YOU"

Readers Say:

There's Plenty You Can Do With a Worn-Out Shoe

IN REPLY to Mrs. E. H. J., who wants to know what to do with the tops of old shoes, I am sending a pattern for a belt. I have made several of these and they are very serviceable. I use a letter punch and sewing machine and a pair of scissors. Make them out of all black shoes or tan. I made one of white and tan. You can make double or single belts.—H. K., Sioux City, Iowa.



WORN-OUT shoe tops make fine leather washers. I use them for kitchen hose couplings, faucets, etc.—P.M.C., Dubuque, Iowa.

IF YOU have any small trees or shrubs that need transplanting, just put the leather from a pair of shoes in with the plant. This is not just a place to put the leather—it also fertilizes the plant. If you don't have any trees to transplant, I guess you are stuck with the shoes.—W. P. H., Columbus, Ohio.

This Should Straighten Out A.V.'s New-Rope Tangle

A. V., who writes the letter on scaffolding rope, will be interested to learn that at least one manufacturer has already investigated the possibility of offering "broken-in" rope, but has found that the cost of "breaking in" at the mill necessitates prohibitive selling price. Far more practical is a "dark" rope, made of the same fiber as No. 1 grade Manila and sold at the same price, but with the individual fibers treated before twisting with a special compound that not only makes the new rope more flexible but, in the case of one brand, also provides 12% to 14% greater resistance to water absorption. This type of rope is widely used by tree surgeons, whose requirements are similar to those of A. V. Actually, the No. 1 grade Manila sold by any leading manufacturer does not even approach the stiffness described by "A. V." who has probably been using cheaper grades.—I. W. T., New York, N. Y.

TELL A. V. to tie one end of his new rope behind a car and drag it about a mile along a dirt road. Presto! The new rope behaves like a lamb.—G. L. O., Puposky, Minn.

draw me

TRY FOR AN *Art* SCHOLARSHIP

Copy this girl and send us your drawing — perhaps you'll win a COMPLETE ART INSTRUCTION COURSE FREE! This contest is for amateurs, so if you like to draw do not hesitate to enter.

Prizes for Five Best Drawings — FIVE COMPLETE ART COURSES FREE, including drawing outfits. (Value of each course, $198.00.)

FREE! Each contestant whose drawing shows sufficient merit will receive a grading and advice as to whether he or she has, in our estimation, artistic talent worth developing.

Nowadays design and color play an important part in the sale of almost everything. Therefore the artist, who designs merchandise or illustrates advertising has become a real factor in modern industry. Machines can never displace him. Many former students, both men and girls who are now commercial designers or illustrators capable of earning up to $5000 yearly have been trained by our Art Course. Here's a splendid opportunity to test your talent. Read the rules and send your drawing to the address below.

RULES: This contest open only to amateurs, 16 years old or more. Professional commercial artists and our own students are not eligible. 1. Make drawing of girl 5½ inches high, on paper 7 inches high. Draw only the girl, not the lettering. 2. Use only pencil or pen. 3. No drawings will be returned. 4. Print your name, address (town, county, state), age and present occupation on back of drawing. 5. All drawings must be received by Oct. 31st, 1941. Prizes will be awarded for drawings best in proportion and neatness by Art Instruction's Faculty.

ART INSTRUCTION INC

(Formerly FEDERAL SCHOOLS, Incorporated)

Dept. 11141, 500 South 4th Street, Minneapolis, Minnesota

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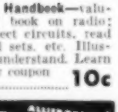

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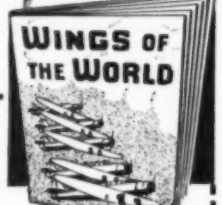

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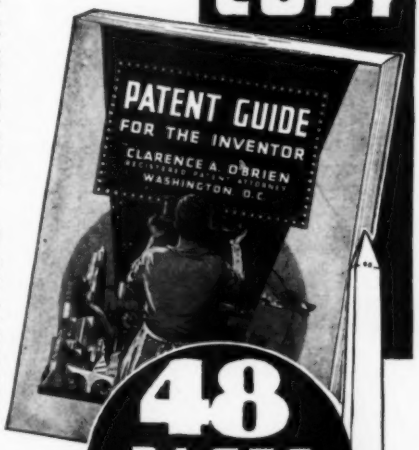

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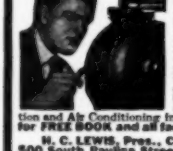

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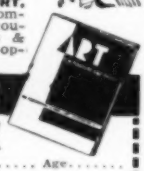

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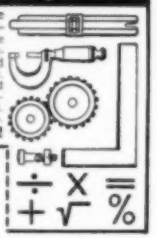

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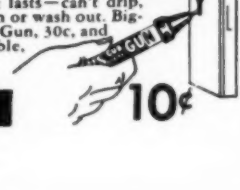

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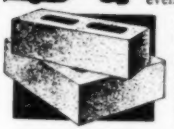

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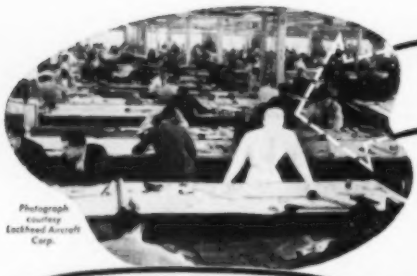

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One of the U.S. Army Signal Corps' newly developed two-way homing pigeons, photographed in flight by William Freese, director of the New York Times Studio, by intermittent-flash light

Round-Trip War Birds

By EDWIN TEALE

THE MOST valuable homing pigeons on earth live in one of the white lofts of the U. S. Army Signal Corps, at Fort Monmouth, N. J. This small flock, numbering less than 100 at present, is composed of the world's only two-way war birds, able to carry messages on round trips across battlefields. Their training has been the most dramatic achievement of army pigeoneers during the more than 2,000 years that message-carrying birds have been utilized in warfare.

In a recent test, 20 two-way pigeons left the Fort Monmouth base and sped at nearly a mile a minute to a loft 28 miles away on the outskirts of Freehold, N. J. After a ten-minute stay, they were released again. Thirty minutes later, they fluttered down at their home loft after a round trip of 56 miles.

The period of intensive training that preceded this feat is a closely guarded Signal Corps secret. But the result is recognized as an advance of vital importance. It will permit Army officers to receive and

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How a pigeon flies. These remarkable photographs were made as birds flew through a tunnel 35 feet long. Four two-way pigeons from Fort Monmouth were used in taking the 25 shots required to complete the set, and the job took three days. Photographer Freese used an intermittent-flash lamp of his own design with a 4-by-5 Speed Graphic camera, stopped down to f/11, and special ultra-high-speed film

send messages with the same pigeon. Nearly 10,000 homing pigeons were in service with the A. E. F. at the end of the first World War. More than 90 percent of all messages entrusted to these birds during hostilities reached their destination, a higher record of success than that achieved by any other form of military communication.

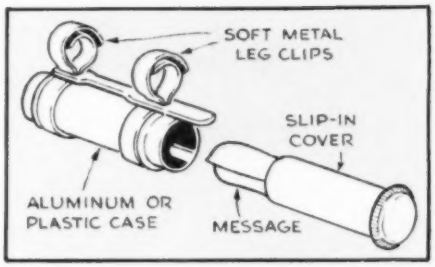
The birds that chalked up that mark were one-way, day-flying pigeons. Available for Army work at the present time, as the result of experimental activity at Fort Monmouth, are birds that will carry messages after dark as well as birds that will make return trips. Pigeons that combine these abilities, and will be able to make two-way trips under the cover of darkness, form the goal of present research.

This painstaking work begins as soon as the birds are able to fly. At the age of four weeks, the pigeons are taken a dozen feet from the loft and permitted to flutter back.

At the end of every flight, they are fed. Fourteen kinds of seeds make up the rations of the Fort Monmouth birds. Each ingredient has its specific purpose. Rice, for instance, by increasing the gloss of the feathers, adds speed to the message-carrying birds.

The method by which the night-flying pigeons were developed is typical of the laborious procedure used at Fort Monmouth. By noting pigeons that flew earlier in the morning and later in the evening than the average birds, the experts chose for breeding stock those with a tendency to fly in dim light. Young birds, produced from this stock, were trained at dawn. Gradually these training flights were lengthened and the time of starting set earlier until the pigeons were flying in pitch darkness. Blue lights on their lofts aided them in landing. At the end of the training period, a flock of these nocturnal homing pigeons covered 14 miles in 18 minutes through darkness.

As an aid to training these and other war birds in field work, 50 specially designed mobile lofts have been delivered to the Signal Corps. Each trailer is a fully equipped standard loft accommodating 140 birds. Original equipment, ideas, and methods have enabled the experts at Fort Monmouth to achieve greater advances in the pigeon service than were made in 20 previous centuries. They are meeting the threat of lightning war—which tries to paralyze an army by destroying its communications.



Army pigeons carry messages in aluminum capsules like the one shown in the drawing, which are attached to the birds' legs as seen in the photograph above. At the end of the World War, nearly 10,000 homing pigeons were serving with the A.E.F.

In training its round-trip messengers, the Signal Corps used mobile trailer lofts like the one at the right, above, of which it has 50. These contain all the equipment of a standard loft, including nests as shown at the left. Next goal of the Corps' pigeon research is to develop night-flying two-way birds

Everybody has a hat—but few know anything about the skillful work that turns a bunny's fur into a headpiece

Pulling Hats Out of Rabbits

By ROGER BURLINGAME

THE WAY a felt hat is drawn out of a rabbit in a modern hat factory is almost as astonishing as the reverse when a magician does it for entertainment. The average person who takes his hat for granted never realizes that the rabbit furnishes most of the raw material from which it is made. Even hat salesmen, who know that felt is made from fur, often think that the hat is somehow beaten into shape out of a piece cut from a roll of felt cloth.

The fact is that the hat actually exists before the felt. Its form is molded direct out of tiny particles of rabbit fur which are sucked onto a cone of the shape of a hat crown. The flimsy fabric which results is put through a series of processes which cause the fur fibers to twist themselves tightly together until they become strong, resistant, soft, smooth felt.

But before we come to the first molding of the hat, we must look at the fur which later seems to weave itself in this curious way.

In order to see the full process from the raw rabbit pelt through to the final trimmed hat ready to wear, I went to Fletcher H. Montgomery, president of the Hat Corporation of America, in South Norwalk, Conn.

The pelts are taken from drums where they have had preliminary cleaning with dry sawdust, slit up the belly, and clipped. The clipping, done by a machine something like an electric razor, cuts off the long hair. (A rabbit has both fur and hair.) The highly skilled sorting then takes place. Here quality and markings are considered, all factors in determining the type and quality of hat.

The next operation gives the fur its felting capacity. It is called "carroting." The fur is brushed with a chemical solution by brushes mounted on rollers. After this treatment, the pelts are piled on trucks—1,000 to a truck—which are wheeled into drying ovens. The degree of heat used and the length of time of the drying determine the kind of carroting. Yellow carroting requires 240°F., for one hour. White carroting takes 160°F., for 2½ hours. The kind of carroting predetermines the quality of the felt.

The skins emerge from the carroting stiff and hard. For the next process, the separation of fur from pelt, they must be softened by wetting.

The separation is accomplished not by

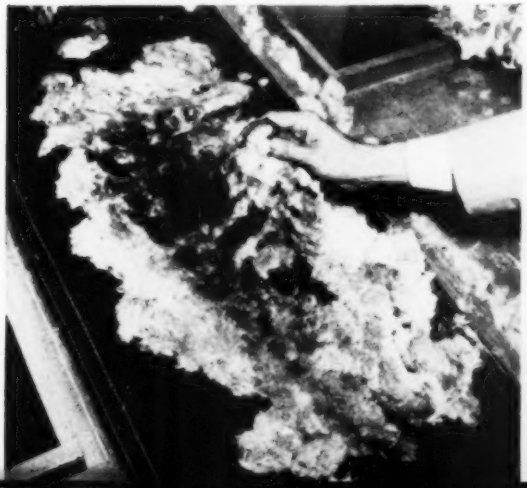
1 Cured rabbit pelts are slit up the belly and the ears, paws, and tails are removed, as the first step in turning them into hats. Then a machine something like an electric razor clips off the long hairs. The best of the rabbit pelts come from Europe and Australia

Photographs by Ralph Morse.

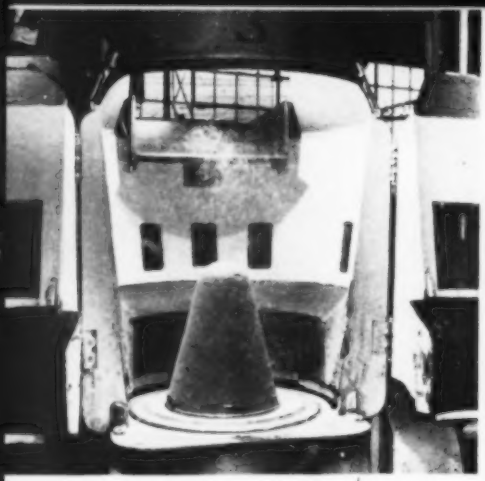
2 Sorting pelts according to color, size, and quality is a job for skilled workers

3 After treating for felting quality, the skins are fed into a machine that strips the pelt from the fur between rollers with spiral blades. The pelt is then sold for glue

4 Here is the fur without the pelt. The machine has done its work so gently that the fur is in the same position it held when it was still attached to the skin



5 Various types of fur, blended carefully to formula for the color and type of hat desired, are mixed here with certain synthetics



6 After careful weighing, the fur is sucked onto a perforated copper cone. Air currents are regulated to control the thickness

7 One of the most delicate operations is "stripping," or removing the fur from the cone. Wrapped in wet burlap, it is soaked in "wetter water" and tapped off

8 Holding the wet fur on his arm, an operator looks through it at a light to hunt for flaws and check the "lay" or thickness

9 The "R-hardening" machine is an H.C.A. invention. To begin felting six hat embryos are put in a roll under the most carefully controlled pressure and wetness

10 On the Genest machines the hats are shrunk and felted to a given size with the aid of hot water, motion, and pressure

11 Hats go into stainless-steel pressure dye machines filled with dye solution, where automatically controlled propellers move them about for 40 or 50 minutes

cutting the fur from the pelt, but by stripping the pelt from the fur between rollers with blades spirally mounted upon them. The pelt comes out in the form of shreds about the size of a shoestring, which are sold for glue.

The machine is so neat in its operation that the fur comes out of it on a conveyor still in the exact pattern it had while it was attached to the pelt. Without touching it, it is hard to tell that there is no skin under it. But as the conveyor passes under the quick fingers of the women who sort the fur, the pattern disintegrates. The fur from the outer edge, being of one quality, is picked up and put in one bag; that from the center of the rabbit's back goes in another, and so on. This is because the quality of the fur, length of fiber, etc., all play a part in the type and quality of the finished hat.

We are ready, now, for the mixing. The formulas have been worked out with the greatest care. A soldier's campaign hat, for instance, will use a very different mixture from the stylish affair a woman will wear with a tailored suit. The eventual color of the hat also demands formula characteristics. Too much dark fur will prevent a felt from taking a light-colored dye. White hats must have special mixtures.

The research division of H.C.A. has introduced another factor into the blending. A synthetic fiber, known as R-53 and derived from casein, has been found to be an excellent felt ingredient. Fifty-two other fibers were tested and discarded by Hat Corporation of America before R-53 was adopted.

The first mixing is done by hand in large bins. The fur and R-53 are then introduced into a boxlike enclosure in which they are kept in a state of constant agitated suspension by a flow of specially humidified air. Usually they pass twice through this mixer. After they are thoroughly mixed they go to the blower.

Here high-speed rolls with small teeth revolve at the rate of 3,500 r.p.m., and throw the fur upward. The hair (such as has remained after the clipping) and other foreign matter, being heavier than the fur, drop from it and the final material for the felt—the pure, clean mixture of furs and R-53—is ready to be molded on the cone.

The precise amount necessary for one hat is now weighed out on scales which register to 1/32 of an ounce. The weighed fur is introduced into the rear of the enclosure in which the cone revolves.

The cone, whose apex is rounded into the shape of a hat crown but much larger, is made of sheet copper perforated with thousands of small holes. It is placed over an aperture through which air is sucked at the rate of 10,000 cubic feet per minute. This means that each hole becomes a powerfully sucking mouth as soon as the exhaust fan is turned on.

When the cone is in place, the doors at the front of the enclosure are shut. Then the fur is sucked onto this perforated cone. It cannot pass through the holes, so it clings there. After a moment, the whole cone is covered with a coating of fur. Now the doors are opened and the cone with its embryo hat is wrapped with wet burlap, and covered with another metal cone, this one having large holes. Then it is removed from the machine and entirely submerged in water at 140° F. The outer cone and the burlap are now removed, and the hat in its first stage is taken from the cone. This is an extremely delicate operation, and is performed by a highly skilled operator.

So far the hat-forming operation looks simple. Its actual complexity comes from the fact that a hat must be of different thicknesses at different points. The brim, for instance, must be much thicker than the top of the crown. The crown itself becomes thicker as it approaches the brim. The thickness ratio varies according to the type of hat. This variable is called a "lay." A "shingle lay" is a more or less evenly increasing thickness from the top of the crown down.

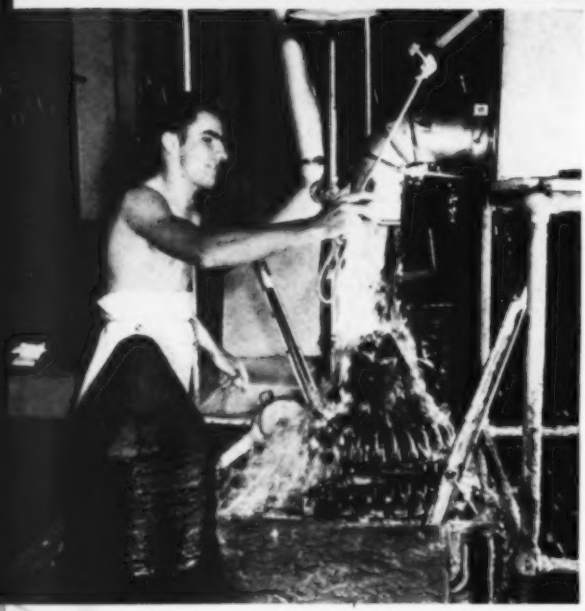
In order to "set the lay," there are windows in the rear of the enclosure which direct the flow of fur particles in varying densities toward various parts of the cone.

The cones are of many sizes. These are determined not only by hat sizes, but also by mixture formula, as certain mixtures require more shrinkage than others before the felting is complete.

Felting is accomplished largely through shrinkage. A laundress or housewife, watching the performance, would see all the things done to a hat which she has tried all her life to avoid in washing woolen fabrics. She would see kneading, squeezing, shrinking with hot water, and setting with cold. But it is this shrinkage which causes the fur particles to knit and twist together until the resulting felt is tougher than woven cloth.

When the embryo hats are peeled from the copper cone, several are rolled together, wrapped in a flannel cloth, and put into a hardening machine, which kneads and prepares them for further operations.

At the H. C. A., after hardening, hats are "R sized" on a machine of the corporation's own invention which shrinks them to a given size with the aid of motion, hot water, and pressure. Pressure is automatically applied to the rolls, ingeniously controlled by an electric device regulated by a knob similar



to the volume control of a radio.

The operations which follow the R method—technically called "R sizing"—"stumping," and sizing, cause further shrinkage. On Genest A and Genest B machines the hats are run under rollers. Both the roller and the apron beneath it have a pattern like the tread on automobile tires and cause suction. There is a constant flow of hot water. Feeding the hats under the rollers is a skilled operation, as the hats must be presented successively to the machine at varying angles.

Between Genest A stumping and

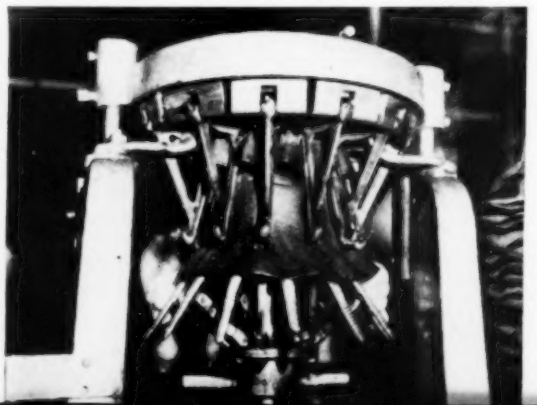
12 Now comes cone blocking. The hat is put over a metal cone and stretched by lifting the cone while its edges are held down. Then it is doused with cold water

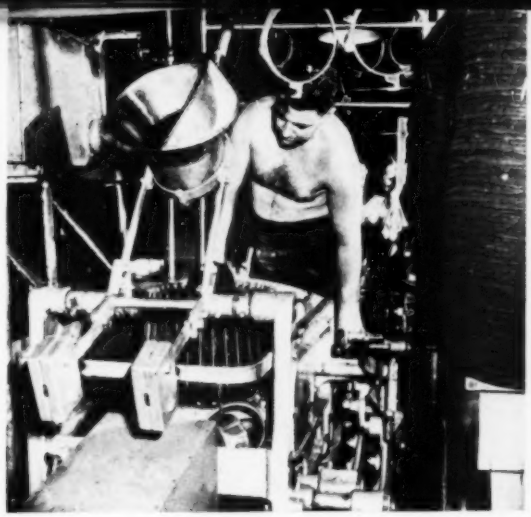
13 The hat is stiffened at this stage by injecting into it a solution of water and shellac. Its density is predetermined

14 So that the blocker will know what head size to make, a worker notches each hat for size identification. Even now, the hat does not look like a hat

15 The hats are now ready to be inspected by skilled hatters. Then they will be sent on to the next manufacturing operation

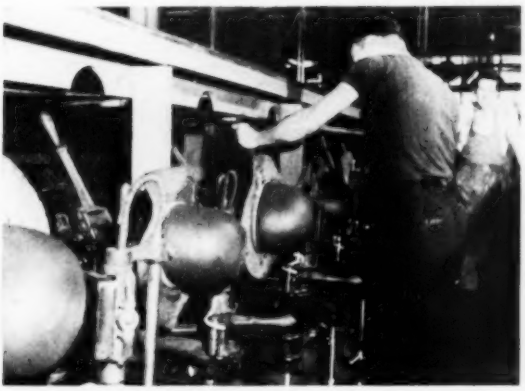
16 The brimming machine, below, stretches the brim away from the cone shape. The crown has already been similarly stretched to shape on a tipping machine



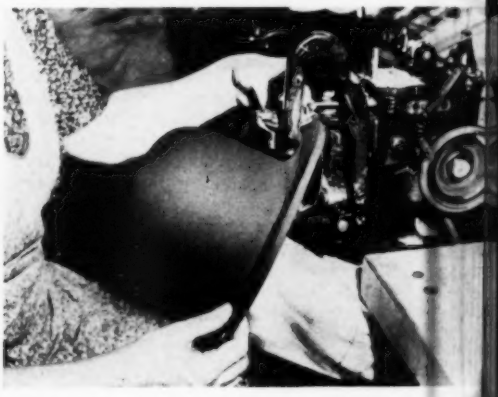


17 During the operation shown in the photograph above the hat is blocked to a given dimension and head size, after which it passes on to the next stage . . .

18 . . . steam blocking. In this phase of their manufacture, the hats are molded permanently to their final shape and style



19 Ironing the crown. Still on the block, the hat is sprinkled automatically and a hot iron is applied to it. Now it really begins to have that new-hat look



20 Now the hat goes up to the "front shop" for trimming. During this operation, the bands, leathers, linings, etc., are attached

21 After "front-shop" workers have added the trimmings such as sweat band and lining, the product is inspected for quality, head size, color, and other things

22 Ready for shipment to your haberdasher. Headgear made by H.C.A. is sold over the country under a dozen trade names

Genest B sizing, the hats are dyed. All dyes are tested by the research department and all formulas are standardized.

Cone blocking follows Genest B. The hat is placed over a metal cone after it has been dipped in hot water. Its edges are held by metal fingers. The cone is made to rise, thus stretching the felt. Then the hat is chilled in cold water, making it retain its shape.

By this time the felting is virtually complete and the hat has shrunk from a cone size of, say, 27 by 30 to 10¼ by 15 inches. Yet the hat, at this point, still does not look like a hat. It looks more like a dunce cap—a perfectly shaped felt cone. The tipping and brimming operations give it its first real hat look. Many-fingered machines mold the crown and the brim, and the brim takes its shape as a real brim rather than a mere part of the cone. Now wet blocking molds the hat to a given dimension and head size.

The finishing operations include steam blocking to the final shape and style, ironing, "jigging"—or "pouncing" with sandpaper—working a finishing solution into the hat with the aid of a hot luer or pad, and slicking. The hats are now ready for trimming, during which operation the bands, leathers, linings, etc., are attached. The next step imparts style to the brim by flanging. The hats are now given their final inspection before being placed in the boxes carrying the many trade names of H. C. A.

Although automatic machines are used wherever possible, there is so much highly skilled labor involved in making a hat that the manufacture cannot properly be called mass production. The machines turn themselves on and off at the right moments, and flows of air and water are automatically controlled. But every operation must be watched by the workers with the greatest care and there are frequent inspections. In a plant like H. C. A., which is dedicated to high-quality production, there is little "assembly-line" technique. The felt hat can never be put through an "untouched by human hands" process.

There are hundreds of details of plant control and management which require incessant attention. All the air in the plant must be specially conditioned. It cannot be too dry or too cold. Through each plant more than 105,000 cubic feet of air per minute pass in and out. It is drawn through aerofins and humidified in varying degrees in the different rooms. Ventilation must be arranged to prevent drafts where the delicate fur is being handled, and yet dust must be controlled.

H. C. A. uses a million gallons of water a day. Every drop of this must be tested by hourly water tests. The water must be clean, soft, and slightly acid. Water cannot be bought in this state so it must be treated.

H. C. A. maintains, under George M. Rickus, the largest research division in the hat industry. Through it all raw materials must pass before entering the factory. This division also constantly checks quality throughout the plant to maintain a high standard of product, and is constantly testing new methods and seeking new and better materials. R-53 (casein fiber) was a development of this division after exhaustive tests on 52 other fibers, both natural and synthetic, had failed to show up to all required specifications. Here, also, the company's R-sizing method was developed.

One of the problems facing the industry today is the threat of a shortage of rabbit pelts due to the European war. While a great many of the American rabbits are being used, they do not produce as fine a quality of fur as the European rabbits, and are not of sufficient quantity to fill the industry's needs. However, the introduction of R-53 into the manufacture of felt tends to help the situation to a certain extent. It is an interesting demonstration of the magic of modern chemistry that this problem has been partially solved by the dairy farmer.

An article which I wrote for the August issue of POPULAR SCIENCE showed some of the values of the new practice of "chemurgy." With chemurgy spinning an improved casein fiber, it is no longer a far cry from a contented cow to a felt hat, as an article in the H.C.A. News points out.

"Since the skins of about 45,000 rabbits are used each working day in this company, and since approximately 8,000,000 pounds of fur are used annually in the entire hat industry of the United States, the development of this new fiber is important, not only to the hatting industry, but to the dairy farmers of the country. One hundred pounds of skim milk yield three pounds of the new casein fiber. If, as estimated, about 1,000,000 pounds of the fiber will be used annually, the farmer has a new market for about 33⅓ million pounds of skim milk."

When I first entered the office of the Hat Corporation of America, I was amused by a point of hatters' etiquette. A guide assigned to take me out to the plant, stopped suddenly on our way out and clapped his hand to his head in considerable embarrassment.

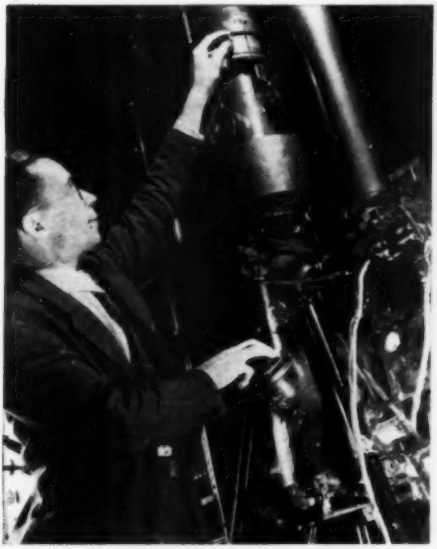
"You've forgotten something?" I asked.

"My hat. I've left it somewhere."

I suggested that, as it was summer, he probably wouldn't catch cold. That, it seemed, was not the point. Looking around the office, he found a sample—a new, expensive, pale gray fedora. It contrasted oddly with his overalls.

"That will do," he said. "We mustn't go out without a hat. It's a question of morale."

Thunderbolt Maker Gives His Rules for Dodging Lightning



Dr. P. L. Bellaschi, director of the Westinghouse high-voltage laboratory at Sharon, Pa., adjusts the vacuum tube of a cathode-ray oscillograph . . .

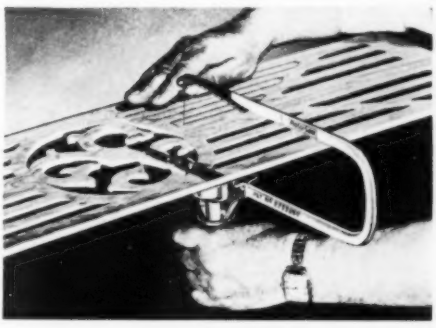
. . . used to measure voltage and duration of laboratory lightning for testing electrical apparatus. Here he studies "pictures" of man-made bolts

GET under cover when you see a thunderstorm coming, if you want to dodge the lightning. That's the advice of Dr. P. L. Bellaschi, research engineer of the Westinghouse high-voltage laboratory at Sharon, Pa., whose business is studying the effects of lightning. In the last eight years he has produced 400,000 bolts of artificial lightning, the strength and duration of which are measured with the cathode-ray oscillograph shown above, to test transformers and other electric power-transmission apparatus. He has also studied many cases of lightning fatalities. Here is his advice to persons wishing to avoid being among the 400 killed annually in the United States by lightning:

Get under shelter as quickly as possible, the bigger the building the better. Stay away from poles, isolated trees, and objects projecting skyward which might attract the lightning. Avoid hilltops and ridges; if no buildings are available, head for a dense wood or valley, or the bottom of a hill or cliff. If you are in a metal-topped car when a thunderstorm breaks, stay there. Recent demonstrations proved that 3,000,000-volt lightning strokes directed at such a car had no harmful effects on the occupants of the vehicle. Keep away from wire fences and metal objects such as pipes.

Motor-Powered Hand Jig Saw Cuts Complicated Scrolls

A BLADE that can be twisted in any direction without changing the position of the supporting frame, and an electric vibrator to provide fast, even motion for the blade, make this hand jig saw ideal for cutting complicated scrolls and other ornamental designs in wood. The length of the loop makes it possible to cut complete patterns in large pieces without removing the blade and shifting the saw frame at frequent intervals.



Modernized Welding Speeded Repair Job on Sabotaged Ships

MODERN welding methods are responsible for the quick repairs which have been made to the damaged Axis ships which the U. S. Government seized last April. Most of these ships are already in service while, with the welding methods used in the last war, repairs still would be far from finished. Earlier welding methods, because of the high welding temperatures used, made it necessary for broken castings to be removed from the ships and put in furnaces for preheating to keep the casting from cracking around the welded spot after completion of the job. This often meant that entire engines had to be taken out before repair work could be started. Today, however, bronze-welding, involving much lower temperatures, is in use, and preheating castings in furnaces has become unnecessary. Thus the castings broken by the crews—they were mostly engine parts—could be repaired right in the engine rooms.

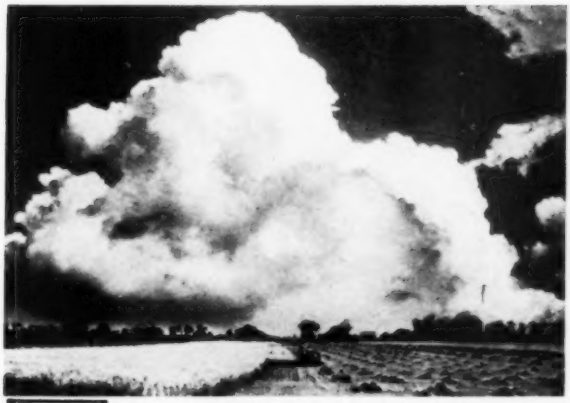
Welding patches in the intermediate-pressure cylinder on an Axis ship that had been damaged by the crew before seizure by the U.S.

Nearly completed, the patch fits neatly in the cylinder wall and has been machined. The mechanic outlines the new piece's contour

Safe and secure on crutches made of welded steel

Seamless Steel Tubing Welded to Make Pair of Crutches

ARC WELDING, which is coming into use in more and more industrial and manufacturing processes daily, was recently used by an arc-welding instructor to make himself a pair of crutches. When Arthur Madson, of Cleveland, Ohio, broke his leg while on a fishing party, he decided that the only crutches he would trust his weight to would be steel ones. Using half-inch seamless steel airplane tubing formed to his own design, Madson personally handled the welding torch with which the crutches were put together. Still sticking to his trade, he used rubber insulation from heavy arc-welding electrode cable to form the arm rests. To give them a more dressy appearance, the crutches were cadmium plated.



Picture Writing

SIMPLIFIES WEATHER MAPS

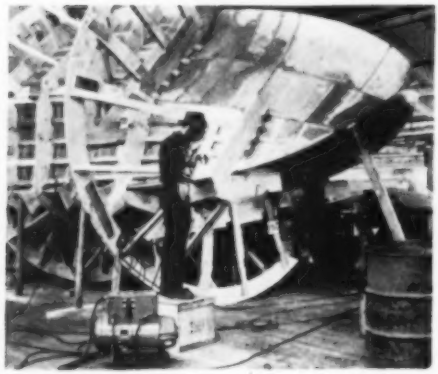
ANVIL OR CUMULO-NIMBUS clouds will be represented on the new maps by the symbol at the left

WOOL-PACK OR CUMULUS clouds, recognized by their flat bottoms, will be indicated by a half circle

CIRRUS clouds, called mare's-tails by sailors, appear in the new sign language as a line with a hooked end

THE weather maps are due for a change. Picture writing, in the form of graphic symbols which are in many ways like the things they represent, soon will be added to them so that a glance at any spot on the map will show what conditions prevail at that point. Straight lines ending in a hook, for instance, will denote cirrus clouds, known to sailors as "mare's-tails"; downward or upward sloping lines will indicate a falling or rising barometer. There will be symbols for drizzle, rain, snow, thunderstorms, and all the other conditions. The new maps will no longer have the isotherms, or lines passing through points of equal temperature, which are on present maps, but the isobars, or lines passing through points of equal barometric pressure, will remain. Air masses will be indicated, with letters to show whether they are of tropic or arctic origin, whether they are hot or cold, and fronts where they come in contact will be shown. This is important because it is along these fronts that sudden changes and storms are apt to occur.

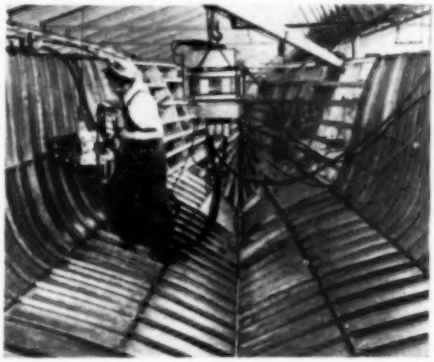
Salt-Water-Resistant Cupro-Nickel Is Used in Hull of Boat



With the hull hove down, cupro-nickel garboards are being arc welded to the keel of an all-metal boat. Shortly before, they had been spot welded

Extremely thin plates of cupro-nickel, which keep their strength because corrosion won't wear them, permit this completely modern streamlined design

CUPRO-NICKEL plates, welded together, form the hull of an all-metal 45-foot motor cruiser recently completed at New Bedford, Mass., as an experiment that may mark an important development in small-boat building. Cupro-nickel, an alloy containing 70 percent copper and 30 percent nickel, is the most salt-water resistant alloy known. It is used extensively in heavy-duty condensers for naval vessels. Because of its strength, the plates of the new boat do not have to be thicker than .08 of an inch. The hull was stiffened by turning up an inch and a half flange on the edge of each plate, and then welding the flanges together. Hull and deck units were fastened with running welds along their inside edges and spot welds along the flanges. The alloy was used also for exposed parts of the superstructure.



Welding together the abutting flanges of shaped alloy to form the hull of the boat. The curved plates are first laid on a temporary wooden frame

Electrical Attachment for Piano Adds Organ Tone to Its Music

ORGAN or piano tones can be produced separately or together with a recently invented electrical device which can be attached to old pianos or built into new ones. It may be used with its own amplifying system or hooked up to a radio with a good speaker. The organ tones are produced by a set of tubes controlled by circuits connected to the piano keys, and the piano is modified so that the hammers striking the piano wires may be actuated by the keys or disconnected. According to the inventors, anyone who can play a piano can play this instrument as either piano or organ without instruction.

SAVING THE
Elephant Seals

Long snouts give the elephant seals their name. This fellow looks ferocious, but he really isn't

Guided by members of the Allan Hancock expedition, which took these pictures, a one-ton seal crawls through a makeshift chute toward a floating cage

THE WORLD'S only herd of elephant seals, living on a narrow strip of beach on the island of Guadalupe off the coast of Mexico, is being saved by the intervention of science. A few years ago poachers were reducing the number of these creatures rapidly, slaughtering them for oil. At one time there were no more than 400 elephant seals in the world. Now the Guadalupe herd numbers more than 1,500, and the giant seals have been found swimming in the Pacific as far as 400 miles from their home beach.

To study these creatures, whose lives still hold many mysteries, officials of the zoo at San Diego, Calif., obtained permission from the Mexican Government to capture several of the monsters. Special methods had to be worked out for trapping and transporting the huge seals, which sometimes attain a length of 18 feet and weigh a ton or more. Smaller 900-pound specimens were rolled into a net and lifted into a small boat for transfer to the cruiser used by the expedition. The full-grown seals, however, required a different treatment. Small boats were overturned on the beach to form an open-bottomed V, or chute, through which the creatures were driven into waiting cages. These cages were, in turn, floated over empty 50-gallon oil drums out to the side of the waiting ship. Although elephant seals are large and ferocious looking, they seldom try to defend themselves against humans. Usually they back away, open mouthed, until they reach the safety of the water.

Smaller specimens are caught in nets and tied up. Weighing some 900 pounds, this one will be put in a small boat for transfer to a waiting cruiser

Protected from sun and blowing sand, scientists of the expedition make a plaster cast of a seal for reproduction and study on their return home

Tumbled in this 14-foot steel drum, an old-style crate for baby bombs broke on the 13th fall, while a laboratory-designed crate lasted for 31 falls

DEFENSE NEEDS SPUR LABORATORY SEARCH FOR

New Uses for Wood

By HICKMAN POWELL

BOMB CRATES designed in the laboratory were not only lighter and stronger, but took up less space, saving vital ship cargo room

THIS incident began when a manufacturer of baby bombs for Britain some months ago found it difficult to get enough white pine to crate his product. There is no way of telling how much it eventually meant in terms of Britain's survival, or in terms of sailors' lives which are lost every day defending cargo space in the North Atlantic.

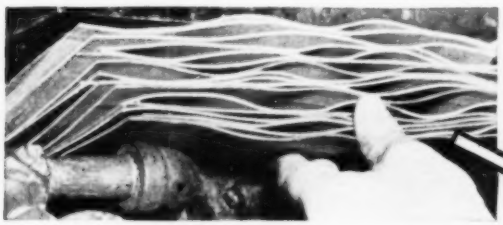
The manufacturer wrote to the U. S. Forest Products Laboratory, at Madison, Wis., seeking a substitute for pine. The upshot was that he crated up the casing for a 250-pound bomb and shipped it to the laboratory for testing of the crate.

Laboratory technicians put the loaded box into a great steel drum, 14 feet in diameter,

and set the cylinder revolving. Fins inside the drum lifted the bomb, then dropped it from a height, pitching it and banging it. On the thirteenth drop the box smashed.

Then the lab men built a crate of their own design. They used cheap aspen, quite as good for the purpose as expensive pine. In place of inch-thick lumber, they used $\frac{5}{8}$-inch stuff, because its springiness would relieve strain on the joints. They used half again as many nails as were in the first box, because it's the joints that take the punishment. The ends of the box they fitted snugly to the bomb shell, holding it firm with tightly tailored cradles, eliminating two inches of useless frame and wedging. The new crate, tumbled in the testing drum, dropped 31 times before it broke.

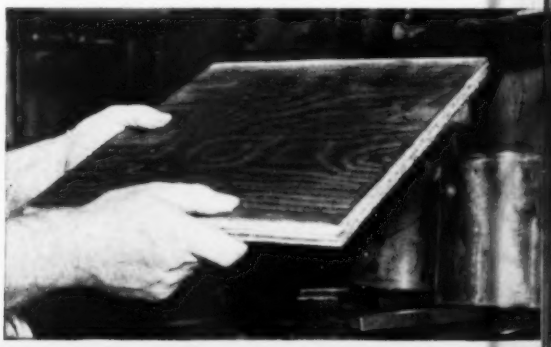
Though a third lighter, the redesigned crate was more than twice as strong. And, far more important, it occupied eight percent less space than the old one. Translated



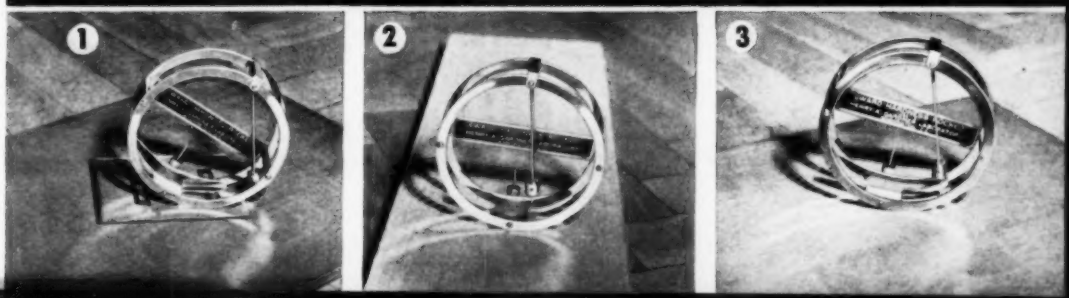
"Compregnated wood," a new material developed at the Forest Products Laboratory, may be the answer to the shortage of aluminum for military planes. In making it, thin sheets of wood that have previously been impregnated with a solution of phenol and formaldehyde are placed in a press . . .

. . . where heat of 310 degrees dries out the water and forms the resin within the cell-wall structure. Here it is chemically combined with the constituents of the cell walls to make a dense, hard substance . . .

. . . like the experimental sheet below. In some properties its strength equals that of aluminum or mild steel, and it lends itself readily to the bag-molding methods used in experiments with plywood planes



A scientific rocker test demonstrates the smoothness and hardness of the new material. On a piece of glass (1) the rocker oscillates for a long time. On a piece of ordinary birch (2) surface roughness quickly checks motion. On compregnated wood, the rocker continues its oscillation nearly as long as it does on the glass



into cargo room, that meant a saving of one ship out of 12 that might be loaded with such bundles for Britain!

On July 1 the regular Agriculture Appropriation Bill provided an extra $150,000 to the Forest Service for work in the laboratory. This sum is earmarked for aviation research, and the late weeks of the summer were spent conferring with airplane engineers as to their immediate needs in wood research. The laboratory men did not sit down at these conferences empty-handed. They were able to present to the airplane men a new substance, developed at the laboratory during the last few months—an improved form of resin-treated, compressed wood which bears high promise of usefulness in airplane construction.

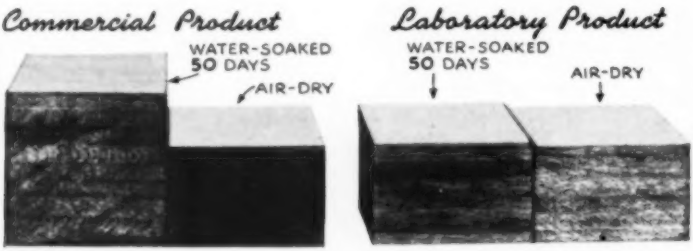
Already the War Department has let a contract for its experimental manufacture into airplane landing wheels, but the laboratory men see its real value as a surfacing for wings and fuselage, as well as for propeller construction—in training planes, if not for combat. Testing will take time, but with the looming shortage of aluminum, the attempts to develop a superior plywood airplane are bound to be intensified.

The materials for the new substance are the same as for the now familiar resin-bonded plywood, which has been coming into use for boat building—thin veneers either dried or fresh-cut, and a solution of phenol and formaldehyde, one of the bakelite mixtures. But while the plywood is merely veneer held together with water-proof resin glue, the laboratory substance is wood in which there is an actual merger of wood and plastic, apparently retaining the best features of each.

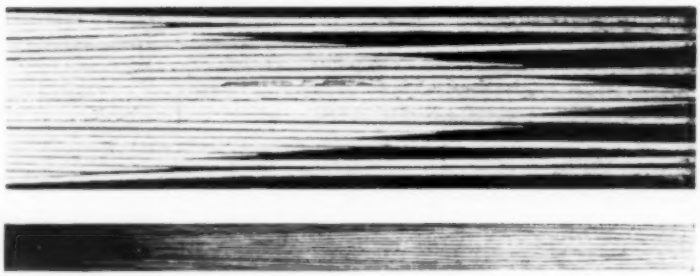
The impregnation of wood with resin followed by its compression is not new. The Germans were doing this before the present war, and American commercial products approximating the German are now in use, notably for the hubs of wood propellers. But in these earlier processes the resin entered only into the coarse capillary structure of the wood. In the new laboratory method the raw chemicals are distributed throughout the cell-wall structure and bonded to it. When heat of 310 degrees is applied, after the water has been dried out, the resin is formed within the cell-wall structure and chemically combined with the hydroxyl groups of the cell-wall constituents.

The result, under pressure, is a dense, hard, strong substance practically impervious to water. Soaked in water for a day, the best prewar German product of the sort increased in weight by five percent. Similarly treated, the laboratory substance added only one half of one percent. Soaked 50 days in water, the best previous American product swelled 54 percent, lost its compression, practically disintegrated. Similarly abused, the new product swelled only 3.6 percent, and retained its strength.

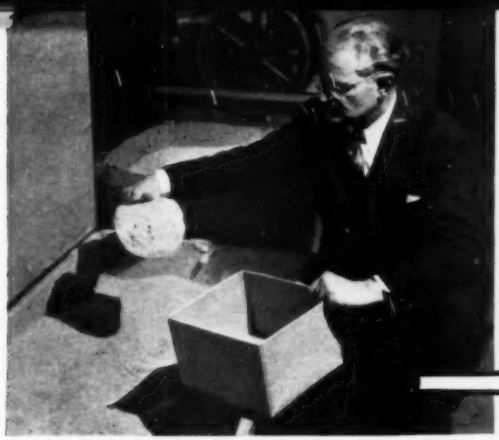
Since one great obstacle to the use of wood, in such precise mechanical contrivances as airplanes, is its instability in the presence of water, as well as its bulk and



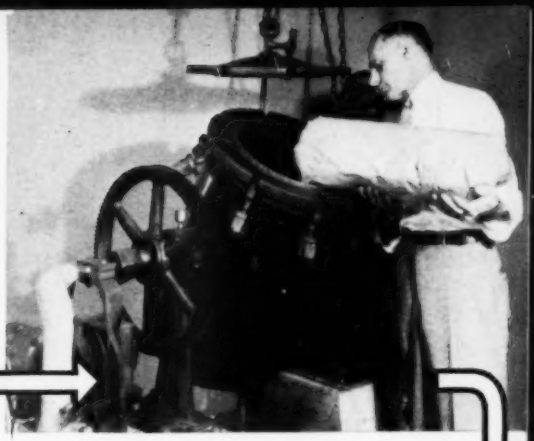
COMPREGNATED WOOD is compared at the left with commercial plywood in resistance to water. Soaked in water for 50 days, the commercial product swells 54 percent, the laboratory product only 3.6 percent



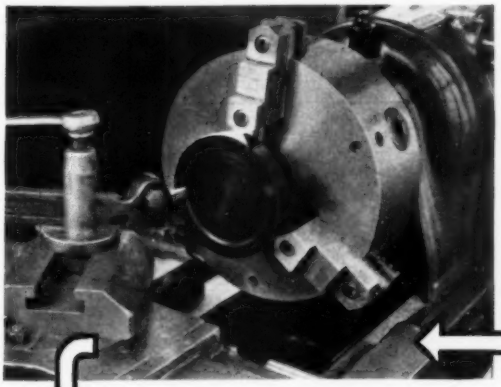
PROPELLER BLANKS can be fabricated from compregnated wood with specific gravity varying from intense compression at the hub end to the natural weight of the wood at the tip. One method of stacking the layers of wood is shown at right, with specimen blank



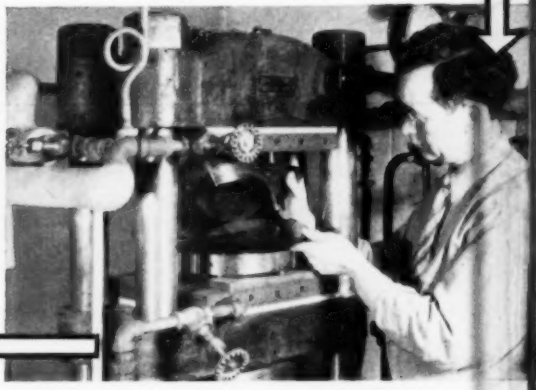
PLASTICS FROM WOOD. As a result of the better understanding of the chemistry of lignin, scientists at Madison produce a low-cost plastic from wood



THE RAW MATERIAL, ordinary sawdust, is first cooked in a closed vessel with a dilute acid, then washed, dried, milled, and treated with a plasticizer



IT CAN BE TURNED easily in a lathe, and also veneered and sawed. It takes paint well, is easily molded, and exhibits a useful resistance to electricity



IN A POLISHED MOLD the resulting powder is subjected to heat and pressure that converts it into a strong, jet-black plastic of many potential uses

MOLDED ARTICLES made experimentally from the plastic at the Forest Products Laboratory are seen in the photograph below

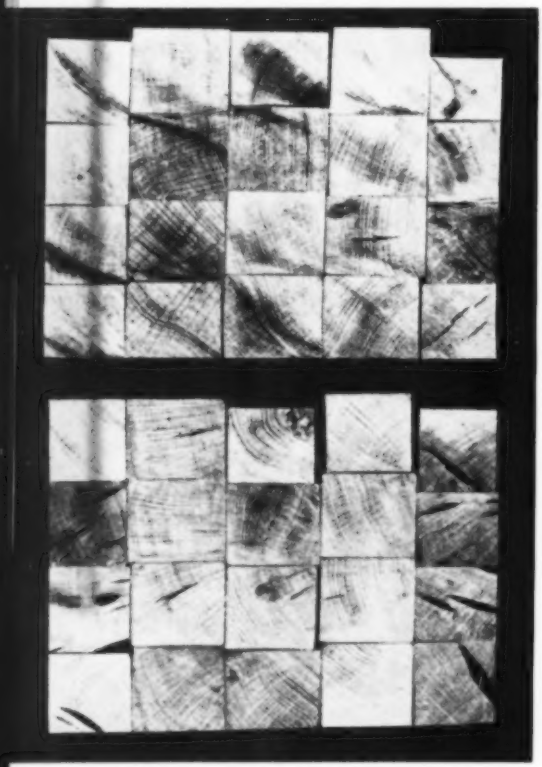
softness, this new development represents a distinct advance. Equally valuable is the ease with which it is compressed, molded, and joined in one operation with uncompressed wood. This makes it especially adaptable to the bag-molding methods now being used for plywood airplanes.

So soft do the veneers become when saturated with phenol-formaldehyde that a stack of plies under pressure of only 250 pounds per square inch is compressed to less than half its original thickness. Under 1,000 pounds pressure it is reduced two thirds. The resultant waterproof surface has a hardness and smoothness comparable to plate glass. The slab is of strength in some properties comparable per unit weight to mild steel and aluminum, with a much greater stiffness because of its greater thickness per unit weight.

The surface plies can easily be compressed

KILN-DRYING HEAVY TIMBERS without checking, by first impregnating them with chemical salts, is another process developed at Madison. It enables the Army to buy light, dry wood for ponton bridges

RESULTS OF CHEMICAL SEASONING of swamp oak. The upper group of timbers, which was seasoned with salts, is comparatively free from cracks. The lower group was seasoned by the ordinary method



while one or more core plies are left uncompressed but bonded to the surface, all in one operation. A three-ply piece, thus made, is still stiffer per unit weight than the completely compressed material or aluminum as it can be made with less than half the weight of the completely compressed wood and less than one quarter of the weight of aluminum.

One trouble with the thin sheets of aluminum used for airplane wing surfaces is their flexibility, which requires a great deal of bracing to prevent flutter. Even so, at high speeds aluminum tends to buckle into a washboard effect, which greatly increases skin friction. It is in the elimination of these difficulties, as well as the extra labor and friction caused by riveting, that laboratory scientists see greatest hope of the compressed wood's usefulness.

Still another mechanical innovation is made possible by this method of compressing wood—the fabrication of laminated propeller blanks with specific gravity varying from intense compression at the hub to the natural weight of wood toward the tip. It would be quite feasible, indeed, by pretailoring the layers of veneer, to mold a whole propeller blade in one operation with density varied at will, all incased in a layer of polished, compressed wood. With the increased size of propellers required by substratosphere flying and high-powered motors, this may be of great importance.

In 1917 the young laboratory, pioneering in an almost virgin field, was able to get spectacular results. Nobody in those days knew much about packing boxes; when the laboratory began studying them, it was able at one stroke to save one third of the cargo

space needed for machine guns and army rifles. Following up through the years, the laboratory developed a whole science of shipping containers, set forth in elaborate specifications published by the Government. Walnut gunstocks were a problem in the World War. Two summers were required for the accepted method of seasoning them, and many thousands of walnut blanks were ruined by bungling attempts to cure them faster. But the laboratory, with its kiln-drying methods, reduced the time to a few weeks.

Similarly with airplane spruce, the time of curing a three-inch spar was reduced from more than a year to a month. If today there were any further urgency about the matter, the time could be cut down to 16 days by soaking the spruce in urea before drying. Energetically during the last war the laboratory worked on water-resistant glues, for laminated airplane propellers, and the researches became the basis for most of what we know today about the gluing of wood, fundamental to the plywood industry.

A few years ago the laboratory developed a method by which heavy timbers could be kiln-dried without checking. This was done by first impregnating the wood with chemical salts, which somehow evened the stresses of drying. The lumber industry did not adopt the method, because it involved somewhat higher costs, but last year it was adopted in a hurry. That was because Army specifications called for a quality of timbers in a hurry which could be produced in no other way. Today for its ponton bridges the Army is buying timbers of a dryness (lightness) and freedom from cracks which would have been impossible before.

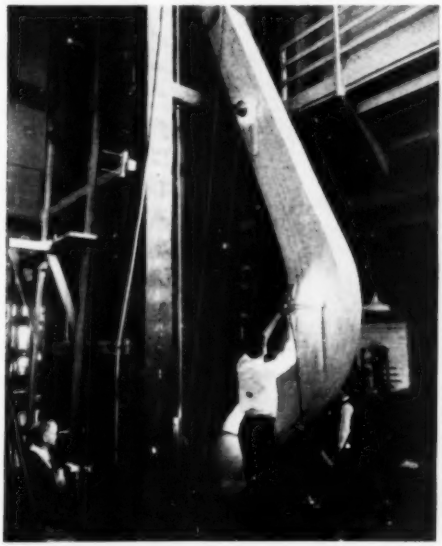
From the scientific standpoint probably the most exciting recent accomplishment of the laboratory has been the hydrogenation of wood and its baffling constituent, lignin. Lignin is the cement which holds wood fibers together, and wood chemists have had no doubt that it can be made valuable. But today it is still a waste product, serving no purpose but to pollute the streams below paper mills and to poison the fish.

The hydrogenation process consists of putting the wood into a cylindrical "bomb" into which hydrogen is pumped to a terrific pressure. Hitched to an eccentric wheel on a motor, this cylinder is agitated at high temperature for hours on end, until hydrogen is gradually compounded with molecules in the wood substance.

By hydrogenation the lignin becomes fully recoverable, broken down into parts which still remain mysterious. One of these is a resin of unknown composition, another is methyl alcohol. Then there are several complex alcohols none of which was known be-

Laminated Timbers Provide Arches for Buildings and Bridges

TESTING A LAMINATED ARCH. Already widely used inside buildings, such structural members gain new value from a method for weatherproofing them



FIRST BRIDGE OF ITS KIND, a laminated-arch over-water span, is appropriately located on the laboratory grounds. Such bridges may become common

fore the development of this process. One of these shows definite promise of value as an antiknock agent for automobile gasoline, if a shortage of tetraethyl lead develops.

Another new process for chemically treating wood consists of chlorination followed by a mild extraction which gives a pulp consisting of 52 percent of alpha cellulose—the raw material of guncotton—much of which is lost in the ordinary pulping process. Cellulose of this quality is ordinarily obtained from cotton linters, the short fibers which cling to cotton seed, but with all the wartime demand for camera film, lacquers, and rayon as well as T.N.T., a shortage may develop in this raw material.

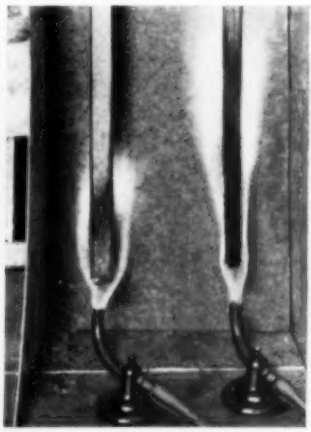
One of the first things the Forest Products Lab is going to do, when it comes into its new money, is to buy one of the fever machines which are used in hospitals to generate uniform heat in objects between its electrodes. The purpose is, strangely enough, to try making a new type of keel for big motorboats, to replace the bolted splice timber construction of keels now in use. That too comes back to a problem in chemistry, and synthetic-resin glues.

The pioneering work the laboratory has done since the last war has been the development of laminated timbers—that is, timbers strongly constructed out of many thin boards, glued together. More and more buildings, such as churches and assembly halls, are being put up today with laminated-arch construction, and they would serve well for airplane hangars. But these arches are put together with casein glue, not sufficiently waterproof for outdoor work or for boat keels. It has never been possible to use the waterproof phenol resins, because a hot-plate press cannot send its heat uniformly through a heavy timber. And once the heat does slowly reach the center of the beam, sufficient to start the resin setting, the heat of the chemical reaction is added and suddenly drives the temperature crazy. Imprisoned in the center of the timber, the heat may even cause charring. With the fever machine it is hoped that heat may be set up uniformly through a thick laminated structure, and set the resin satisfactorily in a short time.

These resins crop up everywhere. Various types are being tried now as a basis for fire-retardant paints. Rain removes the borax so that this paint is not suitable for exterior use. Fire-retardant paints are not being used extensively now, but formulations will be ready when and if Americans become acutely conscious of air-raid precautions.

The laboratory's job is to look ahead. In its new program it will be seeking a substitute for cork, which comes from Spain and North Africa and is already getting scarce. It will be hunting a substitute for Philippine kapok, which is used for life belts and would be cut off in case of war in the Pacific. It is not worried, however, about coconut-shell charcoal, which is used for gas masks because of its great density. Taking up research where the World War dropped it, the laboratory is confident that by compressing wood before charring it, it will soon have a suitable substitute charcoal.

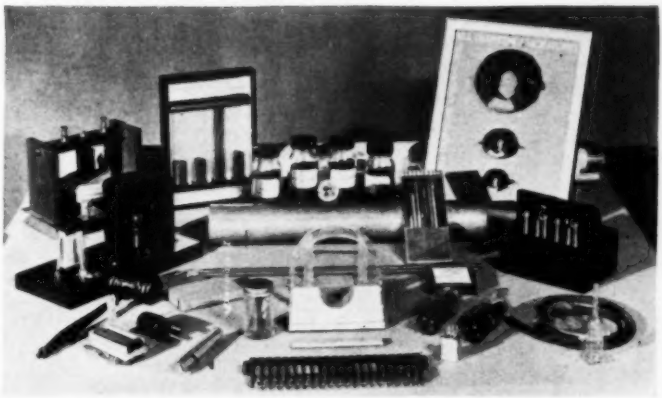
FIRE-RETARDANT PAINT, made by incorporating borax in a linseed-oil paint, may prove valuable for protecting hangars from incendiary bombs. Here a stick is being painted for a test



While the painted stick at the left resists the Bunsen-burner flame, the untreated stick at right burns, as shown by the increased size of flame

Portable Kit Demonstrates Technique of Telephone Science

Built to give laymen a behind-the-scenes view of the modern telephone, the equipment at right is available for science demonstrations to clubs and other groups



Striking a crystal of Rochelle salt, below, generates a sufficient amount of electricity to light a neon bulb. This principle is the one used in many microphone and phonograph pick-ups

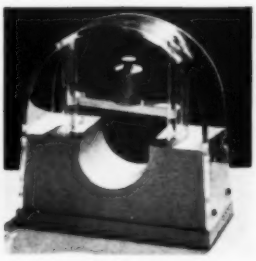
SCIENTIFIC developments which have made modern telephone systems possible can be graphically illustrated with copies of the kit shown above. They can be obtained by applying to your local telephone company.

Changing the shape of some crystals produces current known as piezo-electricity, a principle used in microphones and phonograph pick-ups. A piezo-electric generator consisting of a crystal of Rochelle salt hooked up to a neon tube is part of the kit. Striking the crystal produces enough current to light the bulb.

Below, at the left, is paper coated with diethyl-dithiocarbamate, used to detect traces of copper. It is so sensitive that a finger rubbed against a penny and placed on the paper will leave a print. In the center is a "wobbly bar," made of an alloy that can be so thoroughly magnetized that it will float in the air, supporting three times its own weight, when placed above another magnet of the same material.

At the right is equipment to show how ampules of palladium chloride are used to detect carbon monoxide fumes in manholes. The ampule, imbedded in cotton, is broken, and then placed in the flask. If carbon monoxide is present, the cotton turns black.

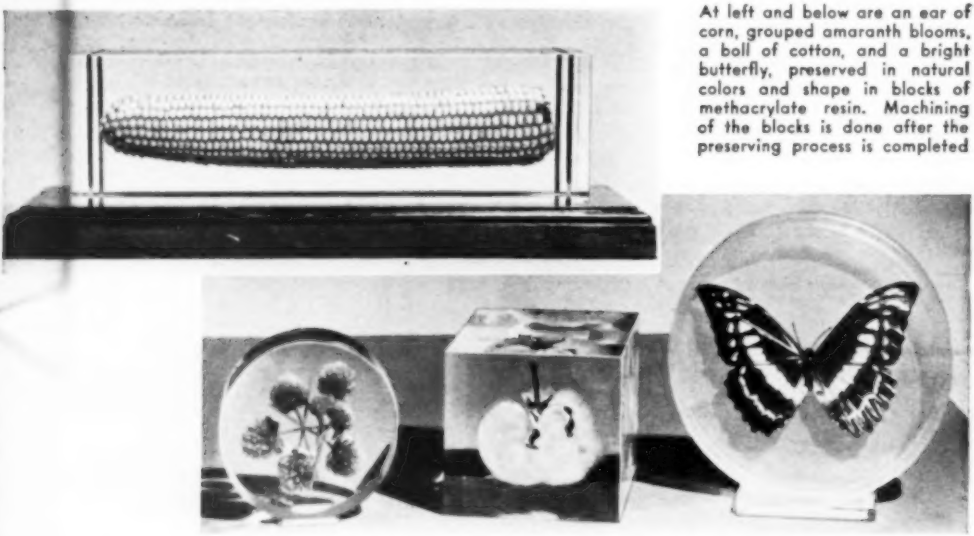
Exhibits show how minute impurities are detected in telephone materials; how a new alloy makes lighter apparatus possible; how carbon monoxide is spotted



Preserving the color of a flower between sheets of plastic. The specimen is immersed at refrigerated temperature for several days, then cured between thin cellulose acetate film before final mounting

Plastics Preserve Nature's Colors

METHODS of preserving the brilliant colors and delicate structures of plant and animal life, even after the objects creating them have died, have long been sought by scientists. Now, thanks to plastics, they can be locked in transparent blocks or sheets and kept indefinitely. Two methods for doing this have been developed by scientists of the U. S. Department of Agriculture. Both involve dehydration of the specimens, for moisture spots the plastics. One method, developed by Dr. Charles E. Sando, preserves the objects in their natural shape in methacrylate resin, a glasslike plastic which can be machined to any shape after the plastic has hardened with the object inside it. The other, developed by G. R. Fessenden, keeps pressed specimens between sheets of cellulose acetate.



At left and below are an ear of corn, grouped amaranth blooms, a boll of cotton, and a bright butterfly, preserved in natural colors and shape in blocks of methacrylate resin. Machining of the blocks is done after the preserving process is completed

World's Deadliest Fighting Ship

AIR CORPS PHOTOS

AIRACOBRA COMBINES SPEED WITH MANEUVERABILITY AND OVERWHELMING FIRE POWER

The Plane on Our Cover

JOHN T. McCOY, Jr., noted aviator-artist, executed this month's cover painting showing Bell Airacobras in flight at night. The same qualities that make this pursuit-interceptor one of the most powerful weapons of the U. S. Army Air Corps give it special value in the new technique of night fighting, which makes great demands on planes as well as pilots.

SEVEN streams of projectiles, one formed by explosive shells from a 37-millimeter cannon and six by bullets from four .30 caliber and two .50-caliber machine guns, make the P-39, latest Bell Airacobra of the U. S. Army Air Corps the most formidable sky fighter in the world. The cannon, firing through the nose of the ship, operates automatically as long as the pilot presses the trigger.

When one of these sleek fighters lifts into the air and streaks away at a top speed of better than 400 miles an hour, it carries three quarters of a ton in guns and ammunition. In addition, there is a quarter of a ton of armor plate protecting vital parts. Designed primarily for interceptor-fighter work, the new pursuit ship is the product of four years of research. The engineers who worked out the design started with a four-fold goal: speed sufficient to overtake any bomber, climbing ability to get above it, visibility and maneuverability to permit the pilot to outfight enemy pursuit planes, and

This innocent-looking ship packs a mighty wallop. Note the cannon barrel sticking out of the propeller hub, unique retractable tricycle landing gear

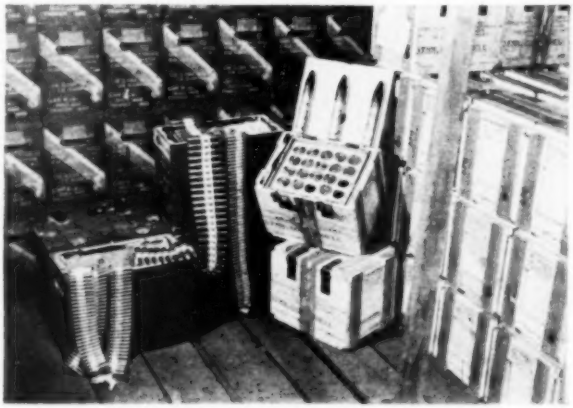
fire power enough to blast the bomber to pieces once the interceptor ship dived on its quarry. Recent tests made in the north woods of Michigan by the first squadron of the Air Corps to be equipped with the new machines, the 39th Pursuit Squadron of Selfridge Field, indicated that all these goals have been attained.

Earphones and throat microphone give pilot two-way radio contact

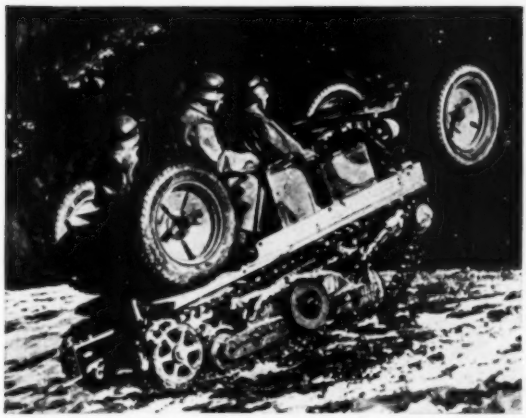
Main stinger in the Airacobra's armament is the 37-millimeter cannon. A direct hit with its explosive shells will knock out any bomber made. These shells are fed into the cannon in belts like machine-gun ammunition, disintegrating links of metal holding the shells together until they are fired. In gunnery practice, the Selfridge Field pilots found that the recoil of the cannon was noticeable every time they headed for ground targets with all guns blazing.

Besides carrying the largest cannon employed in a fighter plane of the Air Corps, the new Airacobra embodies a number of radical departures in design. The 1,150-horsepower, liquid-cooled Allison engine is placed amidships, behind the pilot. It spins the three-bladed steel propeller by means of a ten-foot driveshaft. Automobile-type doors increase the ease with which the pilot can enter or leave the streamlined cockpit. Supporting the machine on its landing and take-off runs is a unique tricycle landing gear which folds into the belly as the ship rises into the air. The electric motor which operates the mechanism can retract the landing gear in 18 seconds and extend it in 12. In the event of failure of this system, a hand crank installed in the cockpit makes it possible for the pilot to extend or retract the landing gear manually with little difficulty.

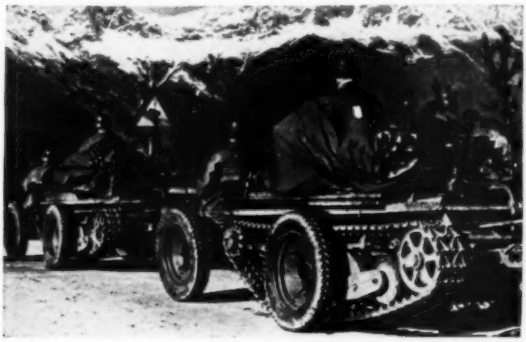
Stings for the Airacobra: shells for the 37-mm. cannon and belts of cartridges for the four .30 and two .50 caliber machine guns. The formidable fighter takes to the air with 1,500 pounds of guns and their ammunition



Shells for the cannon are fitted together with a linked belt of metal and packed in a box as shown at the lower right. In firing, they are drawn into the cannon by a mechanism like that of a machine gun. The pilot aims the 37 by pointing the plane at the target, fires it by pulling a trigger



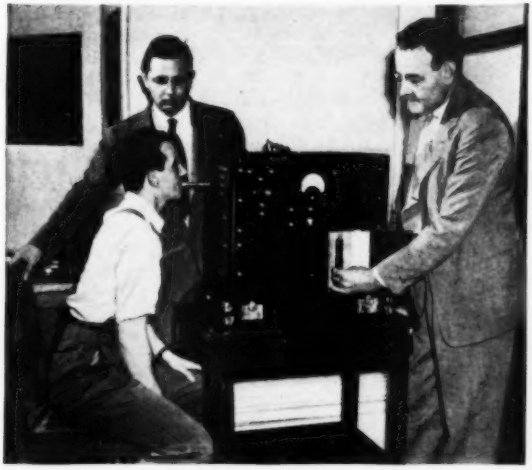
Wheels in the air, tractor treads move the car over rough country, above. Below, speeding along a highway



This "Mountain Goat" Combat Car Uses Both Wheels and Tracks

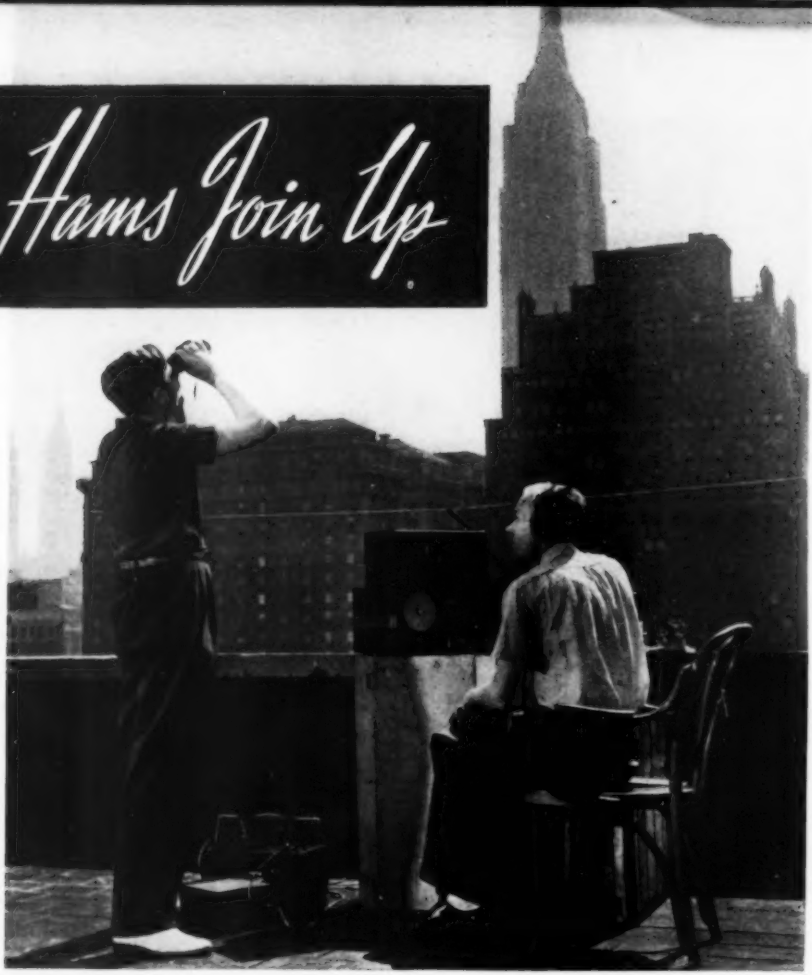
COMBINING some of the best features of tanks and armored cars, a new fighting vehicle is credited to the Germans for use in mountainous country. Labeled a "mountain goat" by some observers because of its speed and agility, the vehicle weighs about four tons. It is said to be armed with a 47-mm. cannon and two 20-mm. machine guns. It has four pneumatic-tired wheels for use on roads, and on these it can travel 50 miles an hour. When the going gets rough, the wheels are hoisted into the air by means of a worm-gear arrangement, and the machine lowers itself onto two continuous tracks of a type especially adapted to use on the roughest kind of terrain. Reports say that the "goat" can maintain speeds of 25 miles an hour on its tracks on level ground. It carries a crew of three men, but it would appear that the positions they occupy in the accompanying pictures are their traveling seats rather than the positions they would take in combat. The machines are believed to be used in "mopping-up" operations on the flanks of an advancing column.

Device Measures Alcohol in Breath to Find Amount in Blood



DRIVERS who are suspected of intoxication won't find it easy to convince the judge that they had only "a couple of beers" if an alcoholometer developed at the physiology laboratory of Yale University is widely used. This device, shown at the left, measures the alcoholic content of the blood by passing a suspect's breath through chemicals and into a colorimeter tube. Different amounts of alcohol in the breath produce varying colors in the tube, and a photo-electric cell activates a meter which translates this color into figures showing the percentage in the blood. The operation takes only eight minutes. To avoid later arguments over the correct reading of the instrument, different colorimeter tubes can be used for each test and filed away.

The Hams Join Up



AMATEUR RADIO OPERATORS, SEASONED BY SERVICE IN FLOOD AND HURRICANE, GET READY TO HELP IN HOME DEFENSE

FIFTY-SEVEN THOUSAND strong, America's radio hams are tackling a new emergency. In the past, these amateurs have starred in time of hurricane, flood, and epidemic. Now they are being groomed for the emergencies of war.

Already 20,000 amateur short-wave stations, scattered throughout the country in towns, villages, farmhouses, and big-city homes, have been organized into groups, or nets. Functioning like the intermeshing cogs of a machine, they form a lightning-fast auxiliary communication system of special value in flashing word of aerial raiders and in directing the activity in communities under attack. The amateurs in these 20,000 stations are holding weekly practice under the direction of 600 emergency coördinators appointed by the American Radio Relay League.

Besides this organization, which is the official spokesman for American hams, two others have been active in training amateurs for the purposes of defense. They are the Navy Communications Reserve and the Army Amateur Radio System. Recently, because virtually all of its members had been called to active service, the Navy Communi-

cations Reserve ceased its amateur-net operations. Previously, it had trained more than 6,000 hams in naval radio problems and procedure. The Army Amateur Radio System, however, has been steadily widening its activity. For the first time in 15 years, its members stayed at their keys throughout the past summer. Previously, their operating season had closed on the last Monday of May. The fact that these amateurs are transmitting, free, thousands of messages to men in Army camps, as well as the tense international situation, dictated the decision to remain active the year around.

The 2,500 members of the A.A.R.S. receive training in both key work and the use of the radio telephone. There are courses in coding and decoding and frequent contests to increase speed. During one of these competitions, not long ago, an eastern ham attained the amazing mark of 65 words a minute when receiving text matter sent by international code.

In the Army's amateur set-up, there are no restrictions as to age, sex, or physical condition. Any licensed amateur who takes part in the regular drills and is able to send and receive 15 words a minute is eligible. The membership is divided into groups that correspond to the nine Army Corps Areas in the United States. Each area has a central signal unit from which the practice is directed. Sometimes, the master station, WLM, in Washington, D. C., takes charge. Practice is held seven days a week. Many amateurs who belong to the A.A.R.S. also are members of an emergency group of the American Radio Relay League.

One of the most complete amateur set-ups in the country has been worked out in Westchester County, N. Y. This vital area extends north along the Hudson River from New York City to beyond Peekskill. More than 100 amateurs in the region spend part of every Sunday rehearsing for wartime and peacetime emergencies. Some, with portable

Mrs. Kay Kibling (W2HXQ), ace radio amateur, has charge of the model defense set-up in Westchester County, N.Y. Here she is operating her 500-watt transmitter with Boy and Girl Scout aids

In an emergency, the hams would help guard strategic points against sabotage. These three have set up portable equipment near Kensico Dam, a key point in New York's water supply

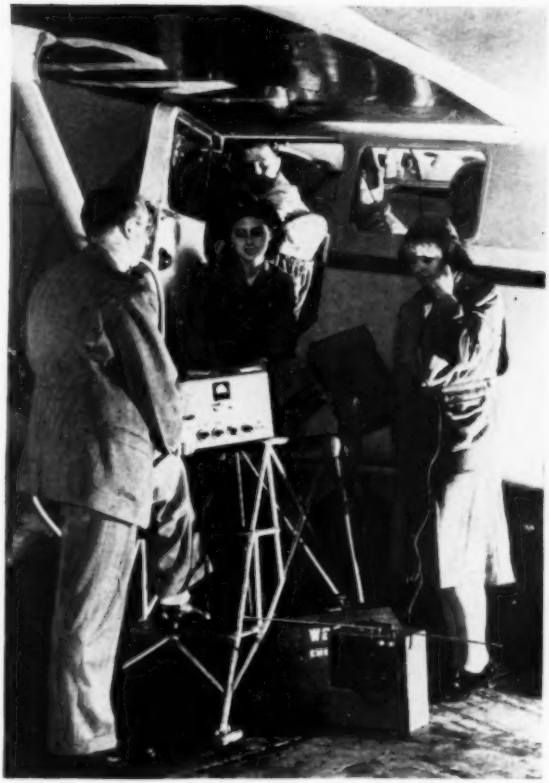
Pushing through underbrush with lightweight transmitters, amateurs rehearse the work they may have to do in watching for enemy planes and keeping tab on fifth columnists

sets, watch for airplanes, keep tab on imaginary fifth columnists, or station themselves at strategic positions such as the Kensico Dam of the New York City water-supply system. Still others, in their homes, relay messages to fire departments, police headquarters, hospitals, and Red Cross stations where other amateurs are standing by to receive them. A dozen communities in Westchester—Rye, Tuckahoe, Larchmont, Harrison, New Rochelle, Port Chester, Eastview, Valhalla, Bronxville, Scarsdale, Hartsdale, and Mount Vernon—take part in these weekly short-wave maneuvers.

In charge of the work is Mrs. Kay Kibling, of Rye, N. Y. One of the outstanding amateurs in the country, Mrs. Kibling has in her equipment a 1,000-watt transmitter, a 500-watt transmitter, a 300-watt transmitter, and seven emergency transmitters ranging from six to 100 watts. The directional-beam antenna she uses in her broadcasts multiplies the signal strength 20 times. In 1938, she won a bronze plaque in a nation-wide competition as the amateur who could make contact with the most countries. She talked to amateurs in 65 different nations before the contest ended. In 1939 and 1940, Mrs. Kibling was in charge of the amateur radio exhibit at the New York World's Fair. Her station, W2HXQ, played an important part in getting messages through during the New England hurricane of 1938.

To add further strength to the amateur radio set-up in Westchester, Mrs. Kibling has been conducting classes to train women in using public-address systems and in aiding hams at their stations. Eighty-one girls and women signed up for one of her recent courses, given at the Rye High School. They were drilled in decoding messages, in speaking distinctly into microphones, and in the best methods for handling emergency work in air attacks. More recently, in a state-wide tour, Mrs. Kibling has organized similar classes in other communities.

Another phase of the work in Westchester is coöperation between the hams and Mercy Wings, an organization of amateur airplane pilots headed by the noted Rye aviatrix, Ruth Nichols. During their practice flights, in which the pilots rehearse



Ruth Nichols, famous aviatrix, trying out a portable set before a test flight. She heads Mercy Wings, an organization of amateur flyers that joins hams in disaster relief

Below is a field radio exchange operated by members of the American Radio Relay League. Set-ups like this have given invaluable service in flood, storm, and disaster

Fire houses are focal points in defense radio networks, along with police stations and hospitals. This picture shows elaborate phone and CW equipment set up in the fire house at Rye, N.Y. Women defense workers are trained by the efficient county organization to help firemen man the sets if an emergency arises

the best methods for aiding stricken communities, they keep in constant touch with radio amateurs on the ground by means of small two-way short-wave sets.

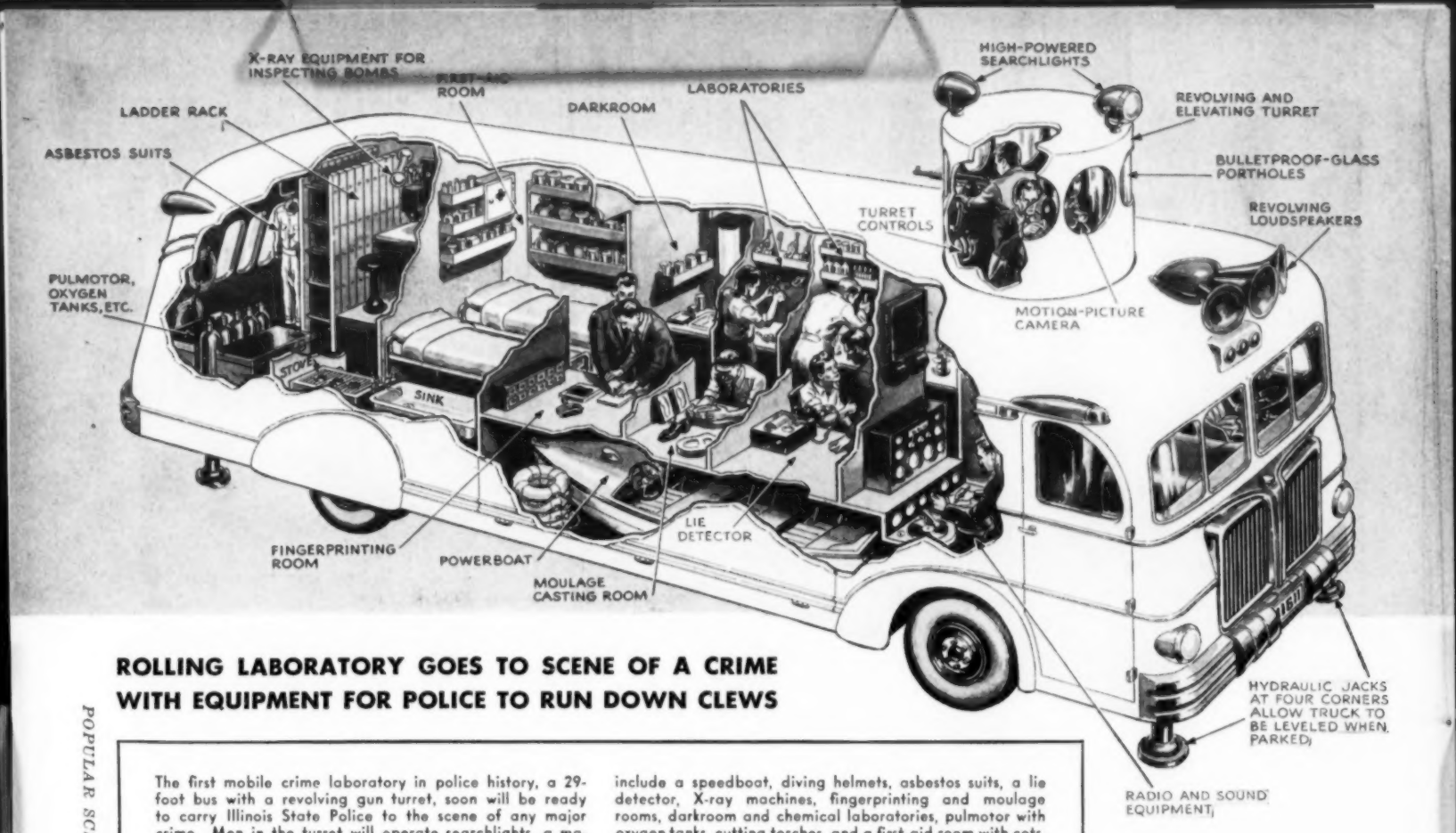
When the present war began, officials in England, Canada, and Australia discovered that hardly more than five percent of the radio amateurs in those countries were qualified to pass the code-work test required for military radio men. By stressing the training of hams in the United States, the Government is building up a reserve upon which it can draw in time of need.

More than two thirds of the radio amateurs in the world live in the United States. Their experience and equipment can be utilized in time of war in many ways. As an aid to air-defense information centers, they can flash in reports of approaching enemy bombers. When telephone and telegraph lines are destroyed by enemy action, they can get messages through by short-wave.

An indication of the importance of amateurs in the present scheme is the fact that recently the Government sent out a call for any hams who have had special training in microwave and cathode-ray technique. Such men, if they hold a college degree, are unmarried, and between 21 and 36 years of age, can qualify for places in the recently organized Electronics Battalion of the U. S. Army Signal Corps. This outfit, under the command of Lieut. Col. W. R. Lansford, will study and operate complex high-frequency apparatus now being developed.

At the time of America's entrance into the first World War, in 1917, the Government virtually padlocked the short-wave stations of American hams. In the present emergency, instead of putting the amateurs on the shelf, officials are seeking the best way to utilize their skill and experience in the interest of defense.

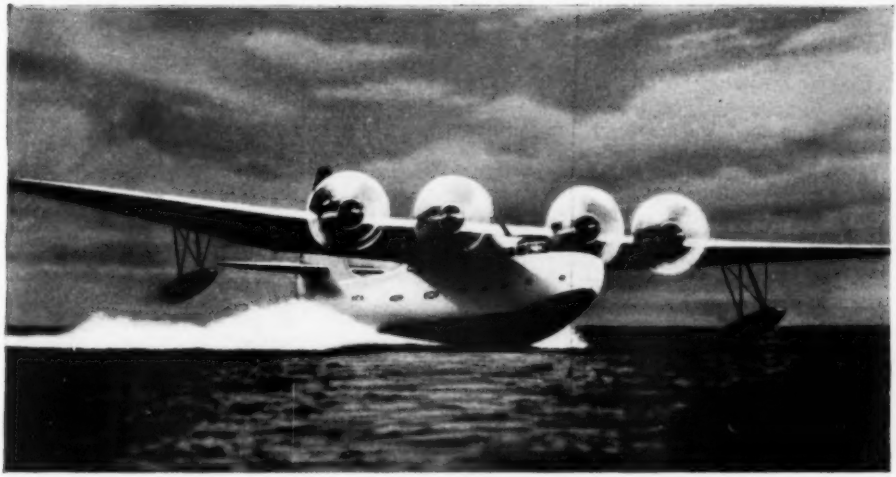
Two-way portable equipment installed on a Rye fire truck. Sets like this would enable fire fighters to keep in constant communication with their headquarters to make reports and receive instructions



ROLLING LABORATORY GOES TO SCENE OF A CRIME WITH EQUIPMENT FOR POLICE TO RUN DOWN CLEWS

The first mobile crime laboratory in police history, a 29-foot bus with a revolving gun turret, soon will be ready to carry Illinois State Police to the scene of any major crime. Men in the turret will operate searchlights, a machine gun, and a motion-picture camera. Equipment will include a speedboat, diving helmets, asbestos suits, a lie detector, X-ray machines, fingerprinting and moulage rooms, darkroom and chemical laboratories, pulmotor with oxygen tanks, cutting torches, and a first-aid room with cots. Police will be able to question suspects and analyze clews.

Drawing by STEWART ROUSE



One of the three VS-44 flying boats built for a new transatlantic service to be started next year

New Planes for Ocean Travel

STEAMSHIP WEATHER REPORTS TO AID SKYLINERS

By David M. Stearns

THREE new flying boats, designed for nonstop service between New York and Lisbon, Portugal, will take to the air soon for test flights. Commercial counterparts of the Navy's "Flying Dreadnought," they have been built for a new company in the transatlantic flying field—American Export Airlines.

When they are put into service next year, world conditions permitting, these planes will fly with the advantage of more complete knowledge of weather conditions over the ocean than has heretofore been available. This is because the steamship company of which the air line is a subsidiary, American Export Lines, is already at work, in coöperation with the U. S. Weather Bureau, making daily observations of weather conditions over the sea.

The new planes, designed by Igor Sikorsky and built by the Vought-Sikorsky Division of the United Aircraft Corporation, are smaller than the 42-ton Clippers of Pan American Airways, weighing only 25 tons with a normal load. Capable of carrying 40 passengers on short hauls, the VS-44's, as they are known, will have sleeping accommodations and living quarters for 16 passengers on the 20½-hour New York-to-Lisbon run.

The weather apparatus which the steamship company has installed on its three ships plying between New York and Lisbon, the *Exeter*, *Excalibur*, and *Excambion*, is similar to that used previously at land stations of the Weather Bureau, and by the Navy, to study air conditions in the upper levels. Its installation, however, marks the first time that such observations have been available to the Weather Bureau from ships at sea on a daily basis. The equipment itself is supplied by the Weather Bureau, but the air line supplies the meteorologists who use it.

The most important piece of this equipment is known as a radio "sonde" or sounding machine. Actually, it is an accurate weather observatory and radio transmitter combined, which weighs only two pounds.

In use, this device is first placed in a conditioning chamber on the bridge of the ship, where it is tested to see that it is functioning properly, and calibrated so that its recordings of upper atmospheric conditions will be in proper relation to conditions at sea level. Then it is attached by a cord to the bottom of a helium-inflated rubber balloon, five feet in diameter and six feet high. Balloon and sonde are then released.

As the balloon rises, the transmitter, powered by a dry-cell battery and connected to three recording devices within the unit, sends out a steady stream of signals on

a wave length of 72.5 megacycles. These signals are picked up by a receiver on the ship, which automatically records the information on a graph.

The signals continue to reach the ship until the balloon has risen so high or has drifted so far laterally that they become too weak for the receiver to pick up. Recordings have been made successfully from as high as 68,000 feet, and over distances of 75 miles. In ordinary practice, however, 60,000 feet is about the maximum effective range of the sonde, while the lateral distance is controlled by atmospheric conditions. It may take an hour for the sonde to reach the point where its signals fade out.

The instruments within the sonde measure temperature, humidity, and height. For the first condition, a thermocouple is used. This is a device consisting of two strips of different kinds of metal, fastened together in such a way that temperature changes set up slight electric currents between them. The currents generated by the thermocouple control one set of signals.

Human hair, preferably from the head of a blonde female, is used to measure humidity. This type of hair has been found to be more responsive than any other kind. When the humidity increases, the length of the hair increases; when the air becomes drier, it contracts. This expansion and contraction controls another set of signals.

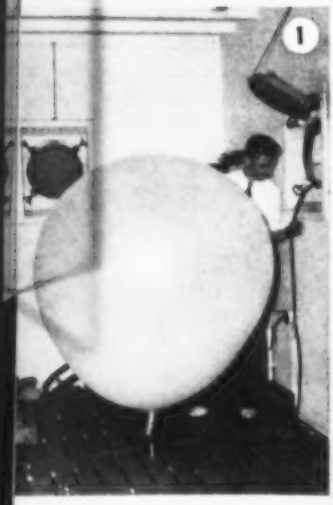
The third instrument is a barometer. This measures atmospheric pressure by expansion and contraction of hollow metal wafers inside of which a vacuum has been created to make them more responsive to pressure changes. Since atmospheric pressure is directly related to height, becoming less the higher you go, a third set of signals controlled by the barometer, interspersed with the others, tells at what height each set of recordings was made.

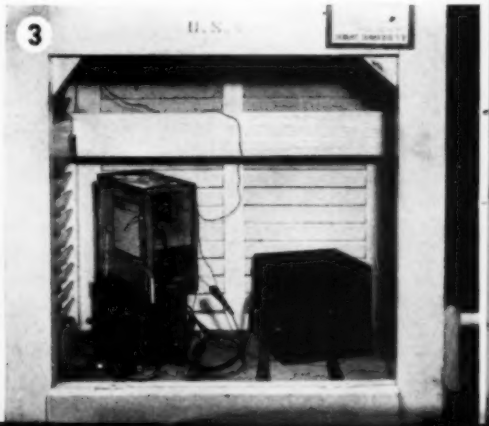
When the last of the soundings has been received, the meteorologist takes the information from the graph in the receiver and sends it by radio to the Weather Bureau, where it becomes available to anyone. This work, therefore, will aid ocean-flying planes of other lines as well as those of American Export Airlines.

Radio sonde observations are at present made once a day from each of the ships at sea, usually about midnight. Then at noon each day, a "pilot" balloon, three feet in diameter and carrying no instruments, is released. This is watched from the ship with a theodolite, an instrument for measuring horizontal and vertical angles, as it rises. From the observed angles the meteorologist can compute the wind direction and velocity at various levels. This information is also radioed to the Weather Bureau.

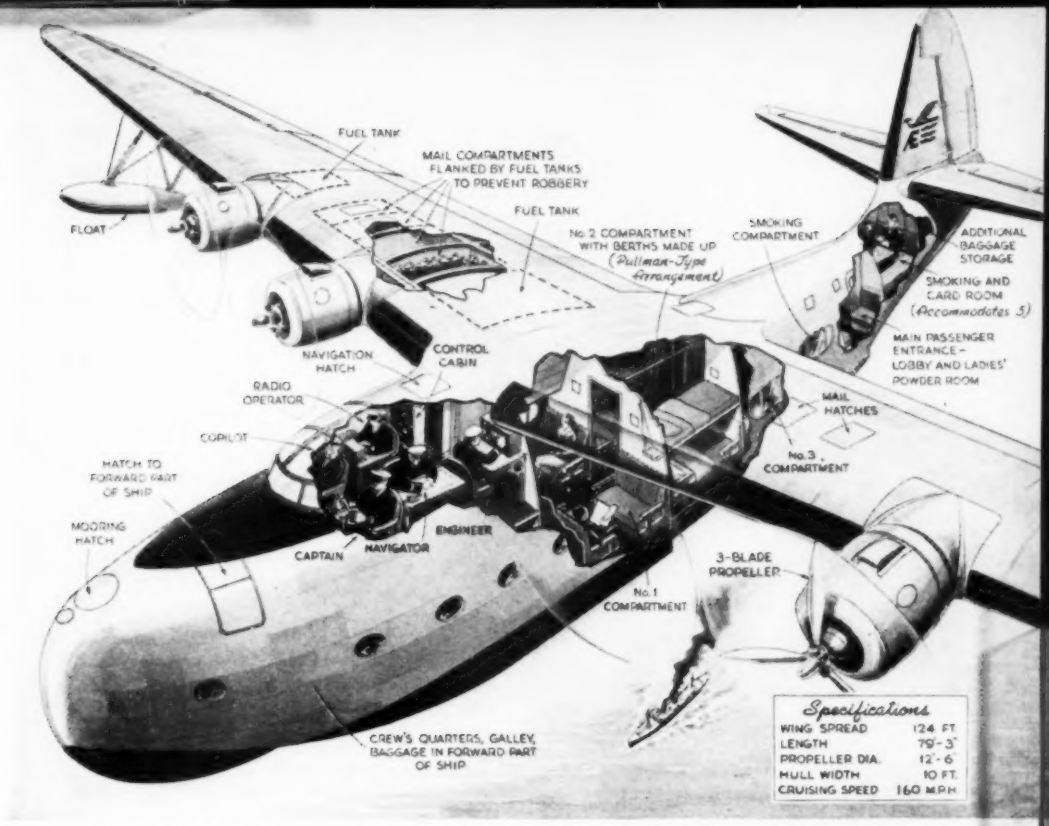
When a radio sonde is used over land, a silk parachute is attached to it so that it can be recovered and used again. When used at sea, however, a complete instrument costing about $40 goes to the bottom as the price of each set of observations.

AUTOMATIC WEATHER OBSERVERS FLASH REPORTS FROM ALOFT



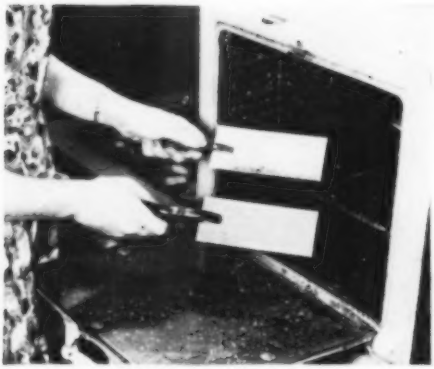


FLOATING WEATHER STATION. In the "weather shack" on the upper bridge of an American Export liner, a radio sonde balloon is inflated with helium (1) to carry aloft the two-pound combination weather observatory and automatic radio transmitter (2). Adjusted to sea-level conditions in a special chamber (3), the radio sonde instrument is attached to the balloon (4) and released. As it rises to higher levels, its weather signals are received (5) and recorded for transmission to the U. S. Weather Bureau. This is the first time such reports have been available daily

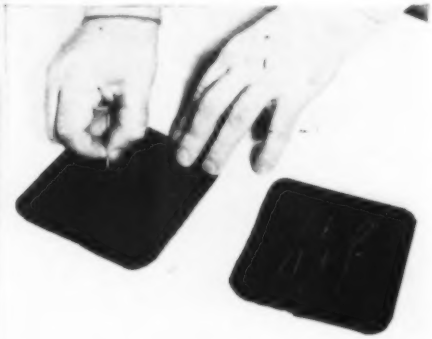


LINER OF THE SKY. A commercial counterpart of the Navy's "Flying Dreadnought," the VS-44 sleeps 16 passengers, has daytime space for 40. It has a top speed of 225 miles an hour. Fuel tanks hold 3,900 gallons of gasoline—enough to take the plane 4,700 miles at its cruising speed of 160 miles an hour

TO SHIPS SERVING AS FLOATING METEOROLOGICAL STATIONS



A sample of melamine baking enamel, at top, retains its whiteness and gloss after baking an hour at 450° F., while ordinary enamel has been discolored



The new plastic enamel is highly resistant to marring. Here, a nail digs deep furrows in a coating of common enamel, but hardly scratches melamine

Melamine plastic tableware resists moisture and stains so well that complete dinner sets of it have been ordered by major airlines for use in serving meals to their passengers

100-YEAR-OLD CHEMICAL FINALLY GETS A JOB

Discovered in 1834, Melamine Now Provides the Basis for a Whole Line of Useful Plastics

PLASTIC DISHES, non-shatterable, lightweight, highly resistant to heat, moisture, and staining; uncrushable fabrics; paper toweling, as strong when wet as when dry; inexpensive automobile finishes that are practically marproof and scratchproof; glistening white enamels that do not discolor with heat—these are just a few applications of a new group of synthetic resins made possible by a chemical that had no known value for more than 100 years, but which has now acquired amazing industrial importance almost overnight.

Known as melamine, a crystalline organic compound composed of carbon, hydrogen, and nitrogen, the chemical was discovered by the famous chemist Liebig in 1834. Until scarcely three years ago, melamine remained merely a laboratory curiosity, obtainable only in minute quantities at about $40 a pound. Then, suddenly, chemists of the American Cyanamid Company discovered that melamine could be used as the basis for a whole new series of plastics and enamels having radically improved characteristics.

At the prevailing price, however, commercial production of plastics and paints from this base was out of the question. How could the material be produced on a huge scale and cheaply? Chemists learned that it could be made in commercial quantities by decomposing dicyandiamide, a form of calcium cyanamid. And calcium cyanamid

is an inexpensive fertilizing chemical made from limestone, coal, and air! An American Cyanamid plant now turns it out by the ton —at 40 cents a pound.

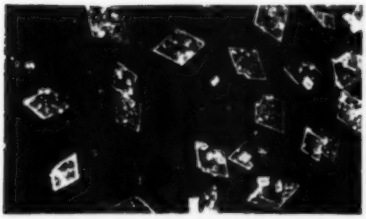
Strangely enough, one of the outstanding applications of melamine resins, which it must be remembered are made in part from black coal, is as a basis for the finest white and light-colored baking enamels ever produced! Until melamine enamels were available, gleaming white and pastel kitchen cabinets, and light-colored metal equipment of all kinds, had to be baked slowly at temperatures below 300 degrees F. Melamine enamels now permit quick baking at temperatures above 400 degrees F., without loss of gloss or whiteness. Because of this resistance to heat, melamine enamels may be applied successfully even to gas and electric ranges—items previously requiring expensive and not too durable porcelain finishes.

Resins made from melamine cure to such exceptionally hard films that a comparatively small proportion of such resin in conjunction with a large amount of cheaper and tough alkyd resin yields a finish having a remarkable resistance to marring and abrasion. Such enamels also resist water, alkali, solvents, and grease, to an extent unusual in non-yellowing coatings.

If your 1942 car has a brilliant finish, which stands up unusually well against scratching, marring, and the general deteriorating factors of cleaning and weather, melamine may again be the answer. Cheaper than the nitrocellulose lacquers previously used, and easier to apply and bake, they may be actually superior in appearance and durability.

By applying an emulsion of melamine resins to fabrics that have already been dyed and printed, a variety of interesting effects may be obtained. Applied to velvet and spun rayon, the result is an uncrushable fabric that can be knotted, twisted, or otherwise distorted, returning always to its original shape. Prepared differently, the resin emulsions produce fabric finishes similar to regular sizing compounds, yet differ from these in that they will not wash out in cleaning.

The greatest field for melamine resins, that of a base for thermosetting plastics, has still scarcely been scratched. Ordinarily colorless, these plastics may be colored with pigment in almost unlimited range. Already, because of its light weight and superior serviceability, complete sets of dinnerware of melamine plastic have been bought by the major air lines. Lighting fixtures made of this material do not darken under the heat of incandescent bulbs, as the urea plastics are apt to do.



Magnified 15 times, these glasslike, clear melamine crystals give no hint of their origin—coal and limestone

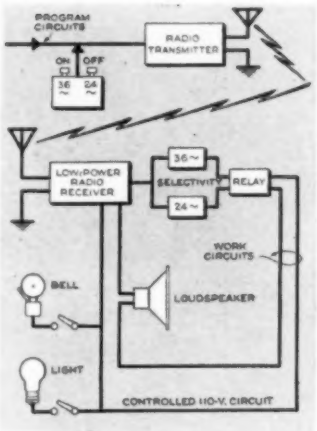
"UNCRUSHABLE" CLOTH is the result when certain printed and dyed fabrics are treated with emulsions of melamine resin. Other cloth acquires the feel of more expensive material. Paper towels impregnated with the resin are as strong wet as dry, as at the left

"Alert" Radio Receiver Stands Guard for Emergencies

Drawing so little current that it can be left on 24 hours of the day, the new receiver will turn on a more powerful circuit to receive an emergency message, and also ring a bell to call or awaken listeners

An inaudible radio signal of 36 cycles sent out by a broadcasting station is used to operate a relay that brings in the loudspeaker. Another signal, on 24 cycles, turns it off

RADIO SETS that would serve as civilian warning instruments in time of air raids or other emergencies are now being produced experimentally. Known as "Alert" receivers, they have a low-power circuit which draws so little current that it can be left on 24 hours a day. An inaudible radio signal of 36 cycles, sent out from the broadcasting station to which the set is tuned, operates a relay which throws in a more powerful circuit which can ring a bell to summon listeners, turn on lights, and operate a loudspeaker through which instructions or warnings can be issued from the broadcasting station. The bells and lights can be located on the set, or in remote positions. Another signal from the station, on 24 cycles, turns the set off again. About the size of a portable radio, these three-tube sets can be manufactured for the price of a small table-model radio, according to the manufacturer, and powered by house current or batteries. Simple in design, they can be made quickly in large numbers.



Microphone Eavesdrops on Termites to Spot Infested Wood

LISTENING for termites is radio's newest job. With the termite detector, invented by Walter Burgess, of Benton Harbor, Mich., and his son, Walter, Jr., the sound of the insects chewing the fibers inside a piece of wood is picked up by a microphone and magnified so that it sounds like dry rice rattling on a piece of paper. Without such a device, wood suspected of being infested with termites must be examined with a probe for cavities or soft spots, and even when they are found there is no way of knowing whether they are caused by termites or rot, unless the wood is in a place where it can be cut apart to expose the spots for a more thorough examination.

Termites make a big racket in the ear of this detector

Landing gear of the Navy's new advanced training plane, seen in flight in the upper picture, folds up into streamlined pockets on the wings

Navy Flyers Win Their Spurs in New Combat Trainer Plane

FOR schooling Navy student flyers in gunnery, bombing, and instrument flying, an advanced combat trainer plane called the Curtiss SNC-1 type has just been developed. It can be equipped with armament, two-way radio, and high-altitude oxygen apparatus for practice under simulated war conditions. Retractable landing gear gives maximum speed under the power of a nine-cylinder, 950-horsepower motor. From this two-place craft, flyers graduate directly to regular fighting planes. In an emergency, it could serve as a defense unit.

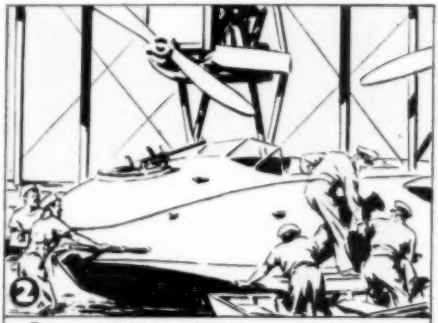
"Stepladder Palettes" Hold Paints for Movie Artists

TO PROVIDE level surfaces on which to place their paints, artists in a Hollywood, Calif., movie studio bend and tack small pieces of cardboard to their tilted drawing boards. Each piece measures nine by 11 inches, with an inch and a half turned under at each end, and a two-inch upright section provided at the lower edge. Upon each six-by-nine-inch upper surface, six blobs of paint may be deposited, giving the artist a wide selection of tints within easy reach. The photograph at left shows the handy aids in use.

Here's My Story

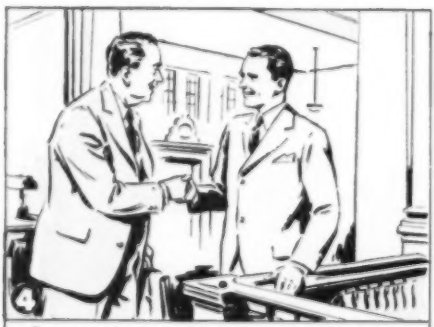
JUAN TERRY TRIPPE, AT 42, HEADS THE WORLD'S LARGEST AIR-TRANSPORT SYSTEM - PAN AMERICAN AIRWAYS

COMING FROM A FAMOUS AMERICAN NAVAL FAMILY, YOUNG TRIPPE WAS INTERESTED IN THE SEA. BUT DESPITE TRADITION, PLANES WERE HIS FIRST LOVE



DURING WORLD WAR I, HE LEFT YALE TO ENLIST IN THE NAVAL AIR SERVICE, LEARNING TO FLY IN 1917 AT MIAMI, WHERE HE QUALIFIED AS ENSIGN, U.S. NAVAL RESERVE

RETURNING TO YALE AFTER THE ARMISTICE, HE ORGANIZED THE FIRST STUDENT FLYING CLUB IN THE COUNTRY. HE'S BEEN "ORGANIZING" AND PRIVATE-FLYING EVER SINCE



AFTER COLLEGE, HE HAD A GO AT HIS LATE FATHER'S CALLING—BANKING. HE DISLIKED IT, BUT LATER WAS TO BENEFIT BY THE EXPERIENCE AND CONTACTS

HE SOON QUIT BANKING TO FOUND LONG ISLAND AIRWAYS, INC., ONE OF THE FIRST "FIXED-BASE" AIR OPERATIONS. HE WAS ITS PRESIDENT, CHIEF PILOT, AND OFTEN MECHANIC TO ITS THREE PLANES

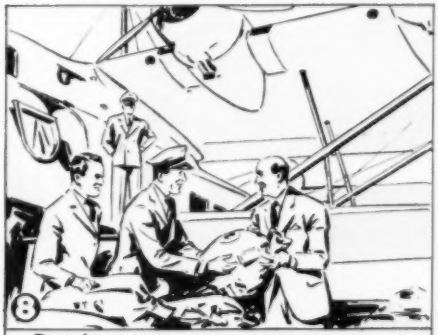
THE CAREER OF JUAN T. TRIPPE

6

IN 1926, HE HELPED TO ORGANIZE, AND SERVED AS GENERAL MANAGER OF, COLONIAL AIRWAYS, FIRST U.S. AIR-TRANSPORT COMPANY TO GET AN AIR-MAIL CONTRACT

7

BUT JUAN TRIPPE HAD ALWAYS DREAMED OF INTERNATIONAL AIR TRAVEL. HE INTERESTED OTHERS, DREW THEM ALL TOGETHER IN PAN AMERICAN AIRWAYS



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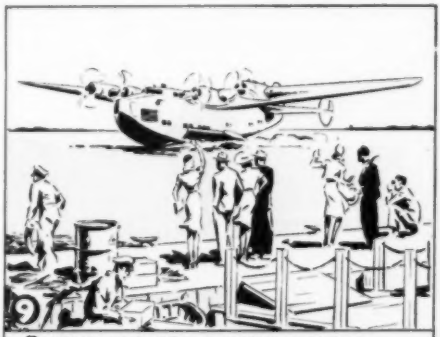
PAN AMERICAN GREW FAST. PRIME MOVER OF ITS SPREADING NET WAS TRIPPE'S GENIUS FOR FAR-VISIONED PLANNING. BY 1935, A TRANSPACIFIC ROUTE TO CHINA WAS READY TO OPEN



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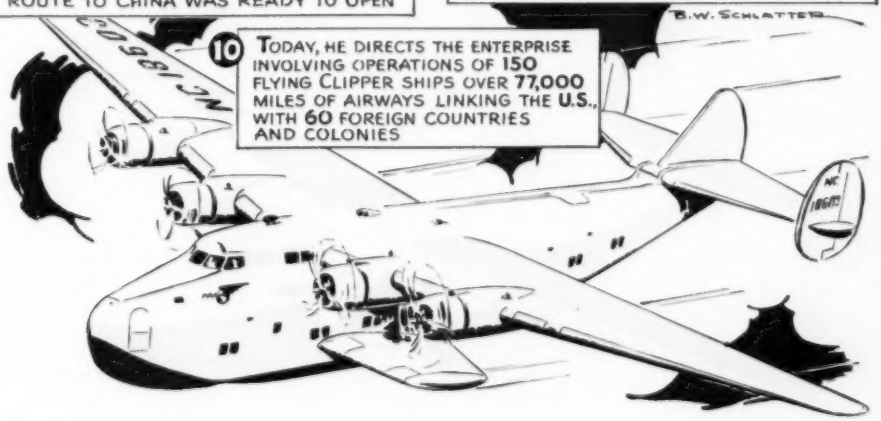
OVERCOMING GRAVE OBSTACLES OF DIPLOMACY, FINANCING, AND ENGINEERING, TRIPPE, IN 1939, BROUGHT ABOUT THE LONG-DREAMED-OF TRANSATLANTIC AERIAL SERVICE



10 TODAY, HE DIRECTS THE ENTERPRISE INVOLVING OPERATIONS OF 150 FLYING CLIPPER SHIPS OVER 77,000 MILES OF AIRWAYS LINKING THE U.S., WITH 60 FOREIGN COUNTRIES AND COLONIES

HARBOR DEFENSE

THE MEN OF OUR COAST ARTILLERY HAVE A BIG JOB

Back of the boom of a 16-inch coast-defense gun is a big job of calculation to make sure that its shell will find the target, some 28 miles away, through changing weather perhaps ten miles in the air

1 At the command post of a 12-inch gun, three men are required to receive and transmit to the gun commander the firing data from the plotting room, which often is located far away in an underground shelter

2 On a large blackboard, the firing range and azimuth, or horizontal direction, are chalked with inch-thick crayons in numerals big enough for all to see. These figures, taken from the men at the telephones, are corrected at 20-second intervals to keep the gun on its target

By JOHN WATSON

EVERY 20 seconds, in the plotting room of a 12-inch gun battery at Fort Hancock, the harbor-defense area of the U. S. Coast Artillery on Sandy Hook, N. J., a bell rings three times. It speaks with the small, sweet voice of destruction, for on the last tinkle of the bell in one of those 20-second intervals, a 1,000-pound armor-piercing shell leaves a gun and hurtles toward its target some 20 miles at sea. In time of war, with our shores threatened, that target would be an enemy capital ship.

For the officers and men in the plotting room, each 20 seconds between ringings of the bell is packed with an astonishing amount of calculation and correction, and except for their intense, efficient work the big slim-snouted shells might just as well remain buried in their well-guarded caverns deep in the earth. Accurate fire by a seacoast battery at a moving target far at sea is one of the most difficult jobs imaginable, yet it is only one of the manifold duties of the Coast Artillery in defending the 20 harbor-defense areas, with their industrial cities and naval bases, which stretch from Portland, Me., to Puget Sound.

Its other phases comprise antiaircraft units with their fixed and mobile guns, searchlight batteries and sound locators; railway guns, almost as powerful as emplaced cannons; mine fields with their own protective units of searchlights and secondary armament; beach defenses, with their automatic weapons and barbed-wire barricades; and, very recently, barrage balloons, to force enemy planes to fly high above vital industrial areas and to establish a silent psychological hazard for enemy airmen

In loading practice, a truck with the dummy shell and powder bags rolls up to the breech of a 12-inch gun

The shell is shoved home with a long rammer. Then the powder bags are rolled over into the loading slot just emptied of the shell, and follow it into the gun breech

3 A gun pointer translates the firing data into movements of the gun in terms of elevation and horizontal direction. Keeping up with the changing data, the gun "tracks" or moves with the target, ready to fire at the command

Weather is important in plotting. Shells may travel as much as ten miles above the earth, and their flight is affected by winds and other conditions. A balloon inflated with hydrogen

. . . is released and its course is followed with a theodolite. Its progress is recorded and reported at intervals, with other weather data

Visual observation from base end stations fixes the position of the target by means of azimuth-finding instruments. Readings go . . .

. . . to the plotting board. Azimuth bearings from the end stations, with the known length and direction of the base line, place the target accurately by triangulation

in night attacks. The U. S. Coast Artillery, taking it all in all, is quite a hefty guy.

Range finding and firing of any of the seacoast batteries or railway guns, starting with the 16-inch guns and descending in size to the 155-mm. tractor-drawn weapons, follows a similar pattern. A description of the method used at a 12-inch battery at Fort Hancock will serve for them all.

First of the factors entering into the tremendously complicated business of range finding are observers who are stationed at either end of a base line, the length and direction of which is known. In this particular instance the observation towers, one on each side of the battery, are some eight miles apart. The observers are equipped with oriented azimuth telescopes which sight on the target and give azimuth readings. Azimuth is simply the horizontal angle, measured in a clockwise direction from a line parallel to the true south line.

Data from weather station and plotting board go to a deflection board, where compensation is made for the direction and velocity of the wind, drift of the shell due to rotation given it by the rifling of the gun, and angular travel of the target as the projectile is in the air. A series of scales combines all these factors

Final firing data, in terms of elevation and azimuth, go to the gun pointers, who operate their controls to keep the weapon on the target continuously. The gun shown is a 155-mm. secondary defense weapon used to guard controlled mine fields

On the range-correction board, allowance is made for muzzle velocity, atmospheric density, height above sea level, temperature, weight of projectile, and wind

The percentage corrector applies corrections to the range and, if necessary, translates the corrected range into gun-pointing units

Now let us assume that we are in the plotting room, with the bell tinkling three times every 20 seconds. In this room is a plotting board, a deflection board, a range percentage corrector, and a wind-component indicator, with operators stationed at each.

Reports from the base end stations on the movement of the target keep pouring into the plotting room each 15 seconds. The large, crescent-shaped plotting board has two arms, each arm corresponding to one of the observation stations. Men called the arm-setters move the arms on the board to the azimuth readings that come in from the observers. The point of intersection of the arms on the board represents the position of the target at the time the last report came in. By knowing the length of the base line and the base angles, the position of the target when observed is obtained by a mechanical solution of a triangle.

This is just one step. At a meteorological

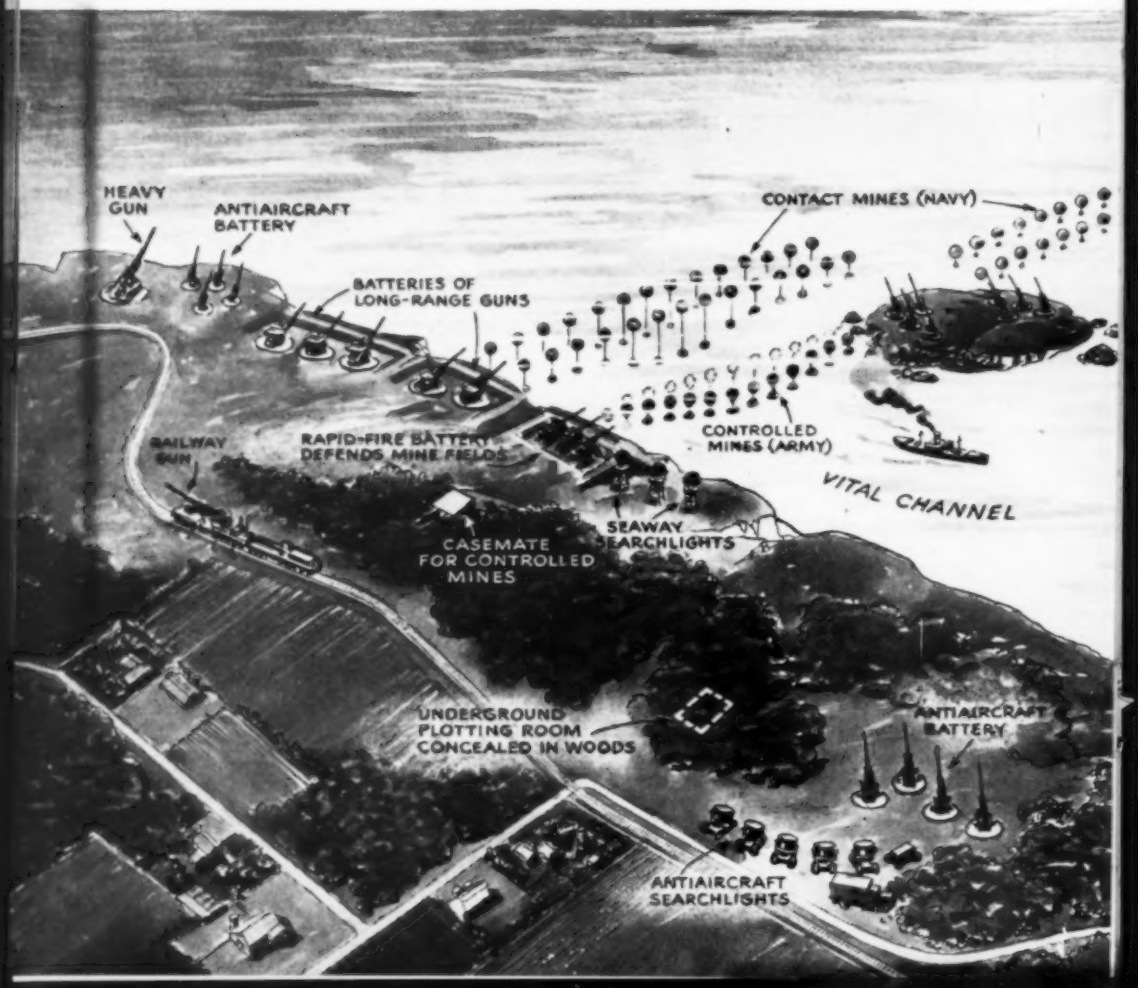
station at the fort, small balloons have been sent up several thousand feet to determine the strength and direction of the upper wind currents. This information is essential because of the great arc in which a shell from a big gun travels. The strength and direction of the surface wind also have been recorded as well as the atmospheric density.

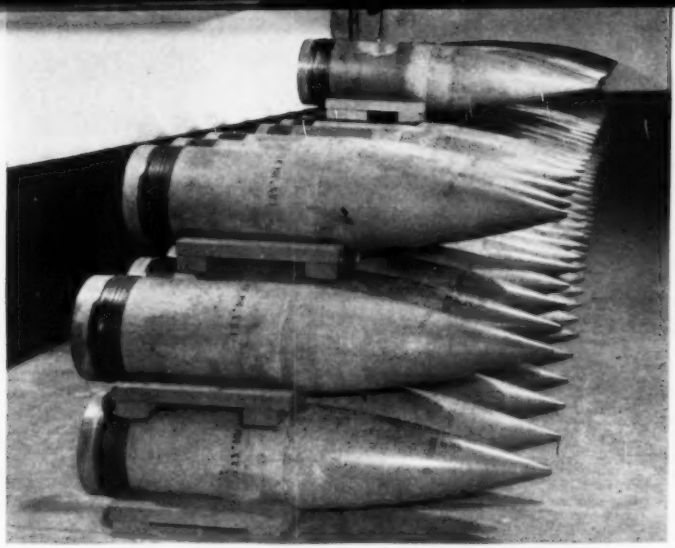
All these reports enter into the range computations, by the men at the range-correction board and the deflection board. The correction-board operator must take into account the atmospheric density, height of the tide, temperature, weight and muzzle velocity of the projectile, the time of its flight, and the rotation of the earth. The deflection-board operators make corrections to account for the windage and also for the drift of the projectile, meaning its tendency to curve by means of the twist given to it by the rifling of the gun, somewhat as a baseball curves by reason of its spin when it leaves the pitcher's hand.

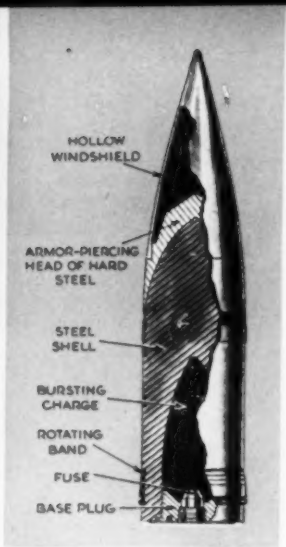
Obviously the windage is a vital consideration. The wind, for example, might be blowing 15 miles an hour southeast on the surface, and in the upper air might be 20 miles southwest. Such differences are solved on the wind-component indicator. All these computations are resolved into distance and direction of the target.

The meteorological conditions, the height of the tide, the muzzle velocity, weight and drift of the projectile, and the rotation of the earth do not, of course, change every 20 seconds, but the azimuth readings on the speed and direction do, and thus all the factors must enter into the computations that are made in the 20-second intervals. The last problem is to calculate the probable spot where the target and a shell will coincide. This is the reason why the bell is set to ring

HOW COAST-DEFENSE WEAPONS WOULD BE PLACED TO GUARD A SEAPORT







Twelve-inch armor-piercing shells stored in a weather-conditioned underground shelter. Row on row, they lie ready to be rolled out to the big guns whenever they are needed. As shown in the diagram, the sharp-pointed noses are really only hollow windshields covering the blunt hard-steel heads to streamline them. These are only the projectiles, the propelling charge being placed in the gun in bags

Constant attention keeps the big guns in condition so that they will be ready for action if called on. Here a soldier is greasing the part of a 16-inch gun that slides back into the recoil mechanism in firing

For economical practice firing, an "ex-caliber" 75-mm. gun is mounted atop the barrel of a 12-incher. When a smaller gun is installed in the barrel of a big one to save ammunition cost, it is "sub-caliber"

every 20 seconds, rather than at a longer interval. In 20 seconds a ship has not much chance to change speed or direction. To a layman, wandering, mouth agape about the plotting room of a 12-inch gun battery at Fort Hancock, it seems impossible that a hit ever should be made. Yet at the last practice firing three hits out of five tries were scored, which is very good going.

Coastal fortifications consist of batteries of primary or secondary armament. Primary armament is that of cannon of 12-inch caliber or more and is for use against capital ships. Secondary armament is of less than 12-inch caliber and is for use against light vessels, or to damage the superstructure of capital ships.

The caliber of the primary armament depends on the particular characteristics of the area to be protected. Sixteen-inch guns are usually placed at considerable distances apart to cover large areas of sea with their range of about 28 miles, while the 12-inch barbette-mounted guns are clustered closer together. A barbette gun is one which is mounted on a carriage which does not move with the recoil, as contrasted with a disappearing carriage which moves with the recoil to guide a gun back below a parapet. Guns of disappearing-carriage mounts have less range than barbette guns.

Besides the big rifles, the types of cannon included in the seacoast artillery include howitzers and mortars. Mortars are intended to lob shells so that they penetrate the deck armor of ships, a duty which is now also being assumed by bombing planes. Howitzers are sort of a cross between a rifle and a mortar—that is, they deliver a curved fire with shells of lower muzzle velocities than rifles.

The following is a list of seacoast and railway guns used by Coast Artillery. The ranges and weights of projectiles given are necessarily approximate, because of the essential restrictions imposed by the defense program, and the data have been obtained from sources dated prior to 1938. ('B' denotes barbette: 'D.C.' disappearing carriage.)

Cannon	*Weight of Projectile*	*Approximate Range*
16″ (B)	2,300 Lbs.	49,000 Yds.
16″ howitzer (B)	2,100	24,000
14″ (D.C.)	1,500	24,000
14″ railway	1,500	40,000
12″ (B) & (D.C.)	1,000	18,000
12″ (B)	1,000	28,000
12″ railway	1,000	28,000
12″ mortar (fixed & railway)	1,000	13,000
10″ (D.C.)	600	14,000
8″ (D.C.)	250	12,000
8″ (B)	250	23,000
8″ railway	200	21,000
6″ (D.C.)	100	14,000
6″ (B)	100	16,000
3″ (B)	15	11,000
155-mm (tractor-drawn)	100	17,000

In taking over antiaircraft defense the Coast Artillery has bitten off another tremendous job, which involves searchlight batteries, sound locators, and fixed and mobile weapons. Antiaircraft searchlights are of 800 million candlepower and under good atmospheric conditions can illuminate a plane at an altitude of almost three miles. They are 13 times brighter than the lights used for horizontal work in sweeping the sea at night and in protecting the controlled mine fields. These latter searchlights are of 60 million candlepower. Some of them are raised above land obstructions and can be lowered close to the ground when not in use, as a means of concealment from enemy planes and surface observers.

The new antiaircraft sound locators used by the Coast Artillery consist of three huge bell-shaped ears rather than four, as in the old models. The ears are arranged in the form of a triangle and the middle ear is common to the other two; that is, it is used in calculating both elevation of a plane and its direction. It takes three men to operate one of these detectors, one man to follow the elevation, one the direction of an approaching plane, and the third to make the readings which are transmitted in turn to the searchlight batteries and the guns. Under ideal conditions the sound locators can pick up a plane 18 to 20 miles away.

One sound locator, five searchlights, and one fixed antiaircraft gun comprise the usual grouping of a small antiaircraft unit. In normal circumstances of defense, listening stations would be set up at the farthest possible point toward the enemy. The searchlights would be grouped some distance behind the listening stations and the antiaircraft guns would be emplaced at least a mile behind the searchlights.

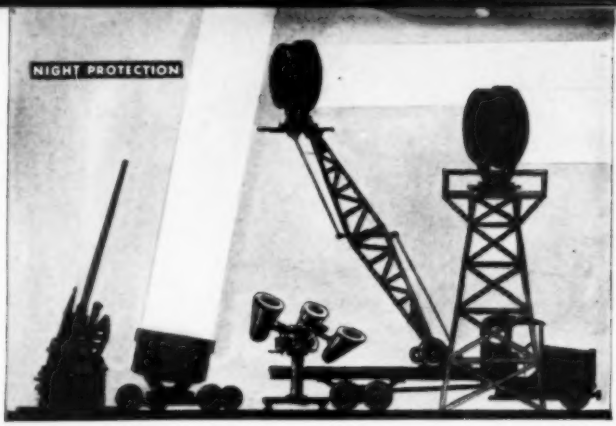
The standard fixed antiaircraft weapons consist of the 105-mm. gun which throws a 30-pound projectile to an approximate height of more than six miles, and the fixed three-inch gun which throws a shell of about 15 pounds to an approximate height of more than five miles.

The three-inch mobile antiair-

Gun-crew teamwork: The man in the center has just swabbed out this 155-mm. tractor-drawn gun. Two men bring a shell

As the shell is placed in the breech, the men with the rammer shove it home. All move with the precision of a good backfield

Now the powderman moves up to insert the charge when the shell is in position for firing. It's all a matter of seconds

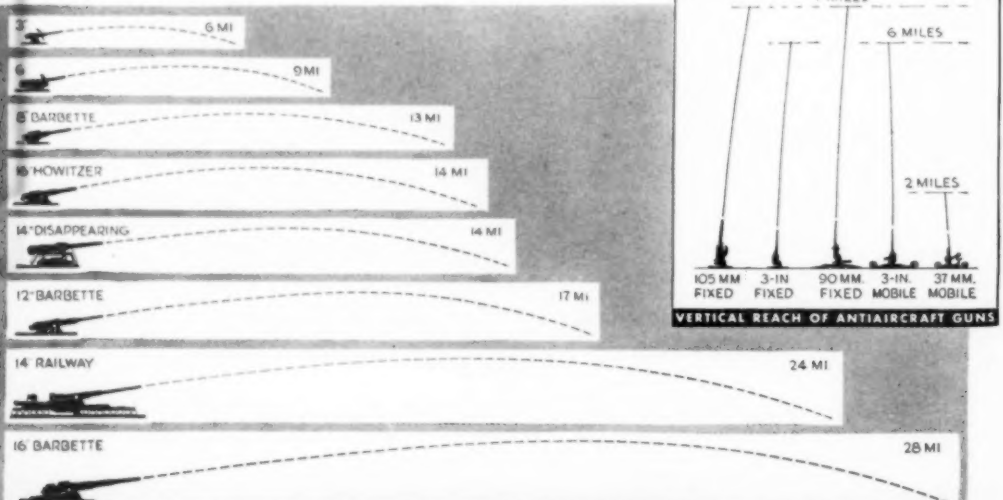


Harbor defense goes on at night, too. Vertical searchlights scan the skies for air raiders, and fixed and mobile lights watch the sea. Antiaircraft defense is a big new responsibility that calls for many fixed-mount guns like that at left

craft gun of the same firing power as the fixed gun is now being supplemented by the 90-mm. gun, the shells of which have time fuses set to burst among a group of invading planes. These guns hurl a 20-pound shell more than six miles in the air. Such is the explosive power of the projectiles that it is not necessary to make a direct hit in order to destroy a plane. In one minute a battery of four of these guns can fire 100 aimed shots. Each gun has a director or mechanical brain which automatically computes the range and transmits it electrically to dials.

Other antiaircraft weapons are the 37-mm. automatic gun which has a vertical range of about two miles; the .50 caliber machine gun with a vertical range of almost three miles and a rate of fire of 500 a minute; and the .30 caliber machine gun with a vertical range of more than two miles. One of the new antiaircraft weapons, now under development, is the American-built Bofors 40-mm. gun. Its performance is an Army secret, but it is designed to furnish protection against low-flying aircraft.

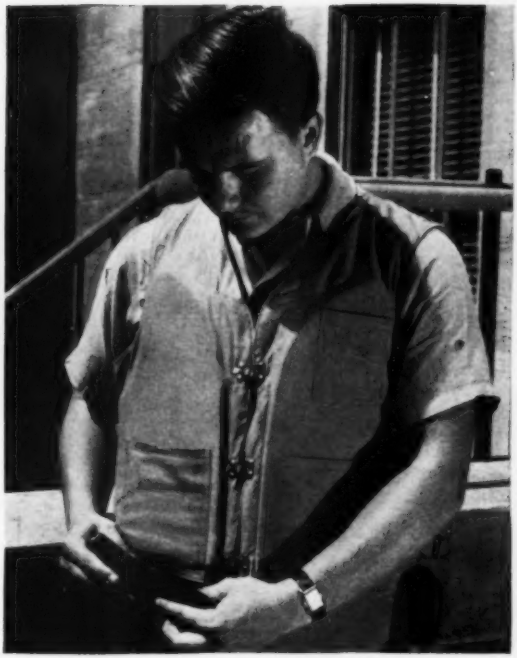
Gun ranges given below are only approximate



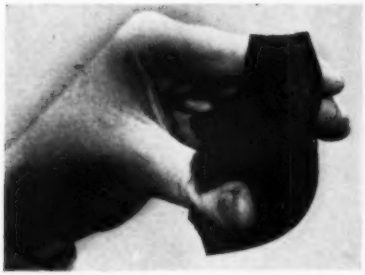
COMPARATIVE RANGES OF HARBOR DEFENSE WEAPONS

VERTICAL REACH OF ANTIAIRCRAFT GUNS

New life jackets adopted by the Navy are made of cellular rubber, a substance which is lighter and more buoyant than cork, and said to be so much more resistant to the absorption of water that it cannot sink. Experiments are being conducted looking to the use of the newly developed material in the building of ponton bridges and rafts

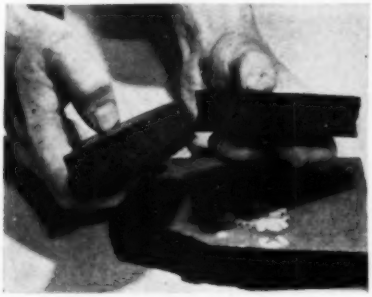


Cellular Rubber



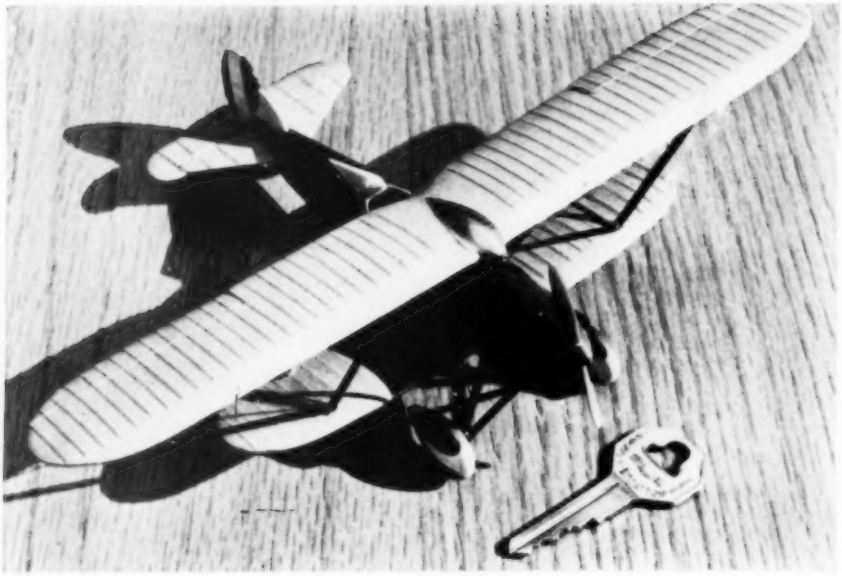
In its soft form, it is extremely pliable

Cross section showing separate tiny cells



RESEMBLING sponge rubber in appearance, but having very different characteristics, a new kind of rubber is proving a valuable aid to the nation's defense. Known as cellular rubber, it is made by a process which forms thousands of tiny cells completely walled off from each other, each cell containing a bubble of gas. Sponge rubber, on the other hand, has cells which run together, and that is why it soaks up water exactly like the natural sponge from which it received its name.

Only half as heavy as cork, cellular rubber is also ten times as resistant to penetration by water, and in contrast to cork, it will never absorb enough water to cause it to sink. Hence it makes an ideal filler for life jackets. Its strength and light weight make it useful in forming supports for self-sealing gasoline tanks in airplanes. Because of its low heat conductivity, it is used as a heat-insulating layer beneath the decks of the Navy's mosquito boats. It is rotproof, and resistant to oil, acid, fire, and termites. As if that wasn't enough, the manufacturers say it can be made in either a hard or a soft form, or in a soft synthetic rubber. However, in spite of its versatility, there is not much likelihood that this new product will be used commercially to any great extent in the near future, because the defense program is calling for almost the entire output of present manufacturing facilities.



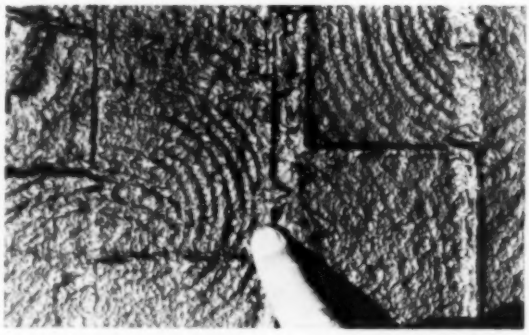
Plane Models

WIN AERONAUTICAL ENGINEERING SCHOLARSHIP FOR BUILDER

MORE than 100 flying and non-flying model planes have won honors for their builder, 17-year-old Donald Coles of St. Paul, Minn. His accurately scaled miniatures of modern types include the Fiat shown above, compared with a car key for size. Other planes embody his own designs. He made three models like the one at right, with a removable cockpit and controls that operate ailerons, elevator, and rudder. An instructor at the Minneapolis airport gave him five hours' flying time in exchange for each. Coles recently won a national contest held by Air Youth of America, and will receive from United Air Lines a two-year aeronautical engineering course at the Boeing School in Oakland, Calif.

Growth Rings Engraved on Steel Bridge Floor

STEEL flooring of New York's Williamsburg Bridge, removed after 10 years' use, was found mysteriously engraved with the growth rings of its wooden paving blocks. An expert at the Bartlett Tree Research Laboratories offers the theory that under traffic the soft spring growth wore away and the harder rings, collecting grit, produced the deeply cut pattern pointed out at right.



Un-Natural History

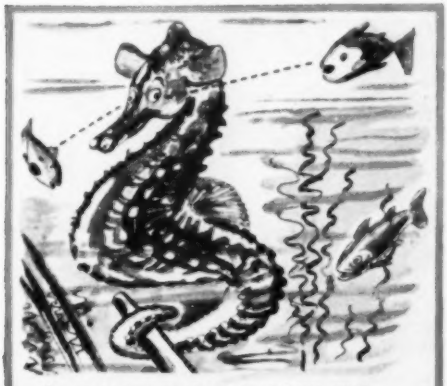
BY *Gus Mager*

THE **PRAIRIE HORNED LARK** LAYS A TERRACE OF FLAT STONES OR CHIPS IN FRONT OF ITS NEST, APPARENTLY TO KEEP THE GRASS FROM GROWING UP TOO CLOSELY AROUND IT!

THE LITTLE **DORMOUSE**, A COMMON ANIMAL IN EUROPE, IS THE ONLY MAMMAL THAT CAN SHED ITS TAIL IN ESCAPING FROM AN ENEMY, AND GROW ANOTHER, LIKE A LIZARD!

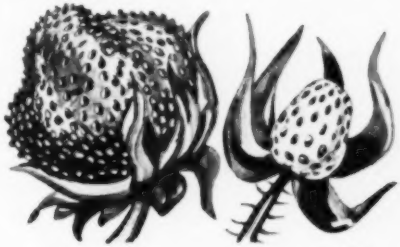
BUTTERFLIES LIVE ON THEIR PAST! IN THE ADULT STAGE THEY TAKE LITTLE OR NO FOOD, USING ENERGY STORED UP IN THE CATERPILLAR PHASE, SO THEY CAN GIVE ALL THEIR ATTENTION TO MATING AND LAYING EGGS!

WHO SAYS WATER CAN'T RUN UPHILL? BOTANISTS TELL US THAT A GOOD-SIZED TREE LIFTS THE EQUIVALENT OF **500** BUCKETS OF WATER AND SAP OUT OF THE GROUND IN A TEN-HOUR DAY!

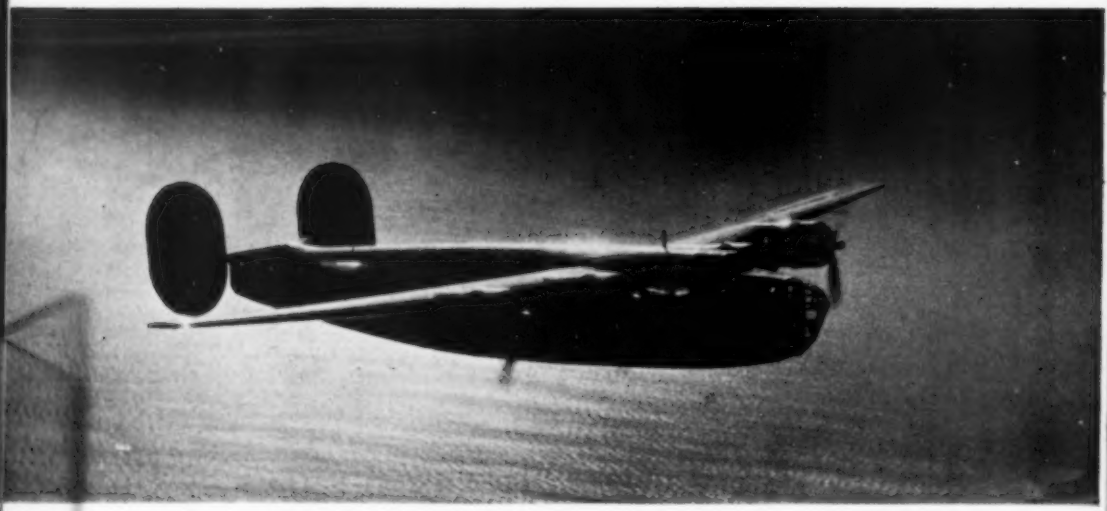


LIKE CERTAIN CHAMELEONS, THE LITTLE **SEA HORSE** HAS EYES THAT LOOK INDEPENDENTLY IN DIFFERENT DIRECTIONS!

WHY DOES THE **STRAWBERRY** SPORT ITS SEEDS BEDDED RIGHT IN ITS DELICIOUS SCARLET CAP, WHILE THE **RASPBERRY'S** CAP MUST BE LIFTED OFF ITS STEM TO UNCOVER THE SEEDS?



War Moves to the Stratosphere



HOW SCIENCE PROTECTS HIGH-FLYING AIR SOLDIERS

By JAMES L. H. PECK

THERE is a weird region of frigid, blue-violet sky from four to seven miles above the earth's surface where death awaits any who venture unprepared. Science, prodded on by Mars, seeks to prepare man for flight into this substratosphere so that he may, singularly enough, deliver death more efficiently from his bombers while flying above the reach of hostile interceptor planes and antiaircraft fire. At the same time science, in other hands, seeks to extend the ceilings of antiaircraft guns and interceptors for the purpose of defense against these high-flying bombing planes.

Safety aside, the bomber crews have another reason for wanting to seek the upper reaches, particularly on long-distance missions. At these levels—say, a mean altitude of 30,000 feet—the air is only one third as dense as at sea level. The bomber, flying at its optimum cruising speed, meets with approximately one third the air resistance it would have to overcome at the same speed at sea level, provided the plane's "thrust"—forward pull of the propeller—is kept constant. Thus, greater economy and higher speed are possible.

But these are high altitudes for heavily laden bombers and the combat crews—pilot, bombardier, navigator, radioman, and gunners—that man them. Getting the bomber and its load up there is the first consideration, and this has been made possible through engineering innovations such as highly supercharged motors, constant-speed propellers, and high-lift wings. Pressurized cabins, decompression chambers, and oxygen masks—by-products of exhaustive physiological research and aviation pioneering—enable the combat crews to withstand the rarefied atmosphere, decreased pressure, sub-zero temperatures, and other unaccustomed conditions.

Power gets them up there. The force to be overcome by the plane's power plant—this includes the propeller as well as the motor—is represented by the total amount of the bomber's "drag," or resistance to the air. This is the reason why increased horsepower, together with efficient streamlining, spells increased performance. Clever supercharging is responsible for most of the power increase that is to be found in today's motors.

This is the means whereby air—which must be mixed with the proper proportion

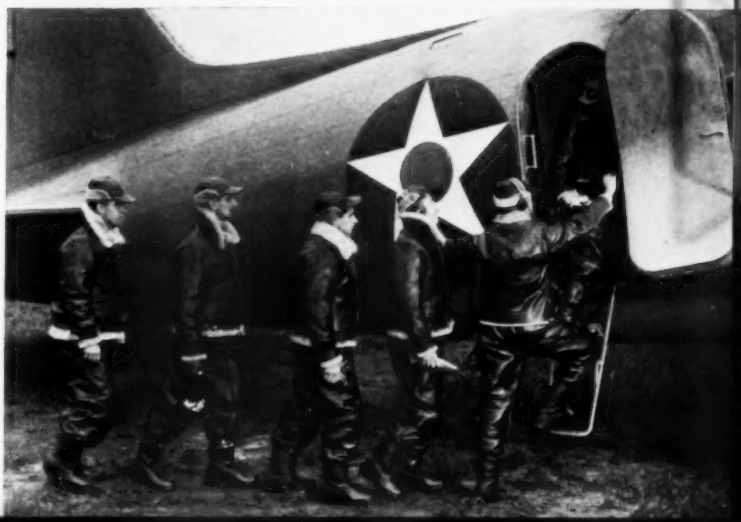
of fuel in the engine's carburetor—is supplied to the engine cylinders at pressure equal to, or higher than that of the surrounding atmosphere. Deprived of this forced draft, the 1,200-horsepower Twin Wasp motors which, for example, power the Air Corps' big Consolidated B-24 bomber, would develop only 525 h.p. each at 20,000 feet and about 260 h.p. at 25,000 feet. From here up, sans supercharging, the decrease would become more rapid; engines, like humans, must breathe.

The centrifugal-type super consists of an impeller, or blower, about 11 inches in diameter driven at high speeds by a train of gears to which it is attached at the rear section of the engine in a casing. Two gear ratios are provided and are referred to as "low" and "high." In the Twin Wasp motor, the blower turns at a little better than seven times crankshaft speed in low gear, which is maintained until a certain altitude is reached. Then it is stepped up to high gear ratio for the long climb to higher levels. This is done because the higher ratio would provide too much supercharging at low altitudes where it was not required, and the bomber pilot would have to fly throttled back to prevent too much of the fuel-air mixture being fed to the cylinders.

The super not only boosts air pressure to make up for the diminution of density at high levels, but also increases motor efficiency by facilitating combustion within the cylinders. The whirling impeller blades agitate or whip the gas-air mixture into such turbulence that a higher degree of vaporization is attained and the charge is heated. The ignition flame, therefore, spreads faster and combustion is more complete. In addition, the mixture is whirled against "diffuser" fins set in the casing in such a manner that the charge is evenly distributed to the manifold and cylinders.

The turbo-supercharger, of which we have been hearing so much of late, is used to supplement the built-in type and is usually installed on the outer side or top of the engine. The motor's exhaust is discharged at a pressure considerably in excess of that of the atmosphere and the turbo-super utilizes this otherwise wasted power. The exhaust gases are collected in the manifold

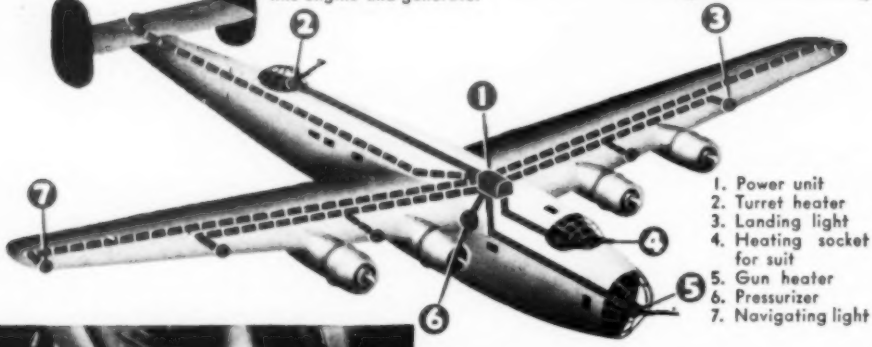
SKY SOLDIERS boarding a big cargo plane at Westover Field, Chicopee Falls, Mass. Planes of this type, when properly equipped, can transport men and materials through the substratosphere



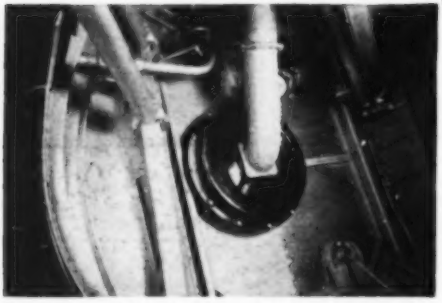
WARM SUITS protect high flyers against the arctic temperatures they meet in the upper air. Each man has a mask and tube with which he can breathe oxygen from a tank in the plane or, if he has to bail out, from a flask he carries in his suit

Ingenious Mechanical Equipment Gets Bombers to High Altitudes and Guards Their Crews Against Cold, Thin Air, and Low Pressure

To supply current for the pressurizer, gun heaters, and other electrical equipment shown below, the auxiliary power unit at right combines a small gasoline engine and generator



1. Power unit
2. Turret heater
3. Landing light
4. Heating socket for suit
5. Gun heater
6. Pressurizer
7. Navigating light



This is a cabin supercharger, or pressurizer—a centrifugal blower that keeps up the air pressure in the sealed cabin. At 30,000 feet, it maintains pressure equivalent to that outside at 10,000 feet

and directed through a small turbine compressor, which, in turn, rotates a centrifugal blower on the same shaft, sending the boost on to the carburetor. The used gases are, of course, discharged after they pass through the turbine.

Retaining engine power in the substratosphere is only a part of the story. Controllable propellers are required to provide thrust; after all, the engine's purpose is solely the turning of the prop. With supercharged engines, the prop should take bigger bites of air at high altitudes than at sea level, but this can only be accomplished if

At 2,000 feet, a test subject in a plane begins recording his reactions to high flying

A sample of normal handwriting in flight at 2000 ft.

At 15,000 feet, muscular incoördination begins

15000 ft - feel uneasy generally prickly feeling some numbness in leg and hands

20,000: Incoördination worse; note zero dropped

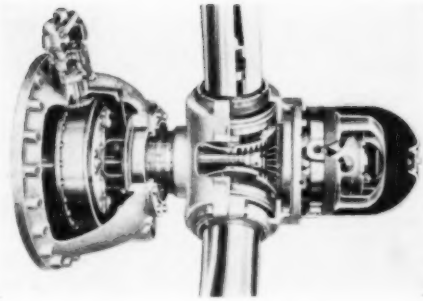
20000 ft: faint - numbness in legs: vision fading

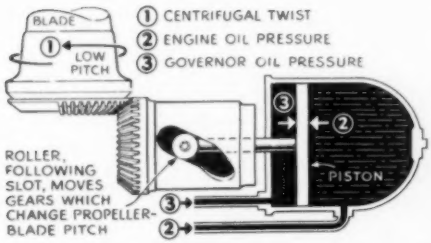
24,000: He is mentally and physically helpless

24000 feet - Oxygen started a/r

At 26,000, a whiff of oxygen brings improvement

26000 ft. Thing lost lightly - Hearing returning feel O.K. now -

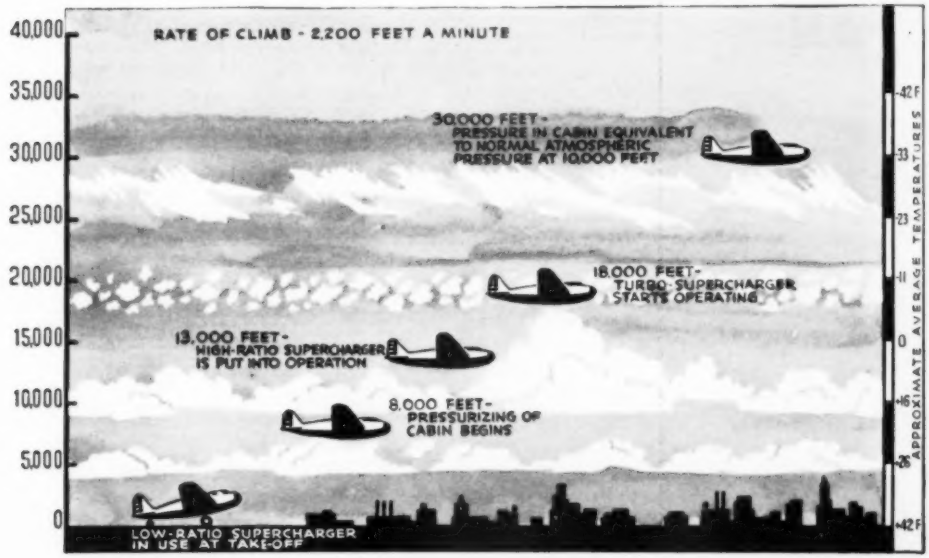




HYDROMATIC PROPELLER automatically adjusts its pitch to the load, keeping engine speed constant. Diagram shows how engine oil pressure works against governor oil pressure to change blade pitch

ICE FORMATION on wings and fuselage presents another problem. At the right an engineer studies a model plane in a refrigerated wind tunnel as a part of the research on improved de-icing methods

HIGH-ALTITUDE AERIAL PHOTOGRAPHY calls for special equipment, too. These men are taking aboard an aerial camera of the type used in mapping large areas from reconnaissance planes



Ordinary suits for high flying are of sheepskin with the wool inside. Naturally, they are heavy, clumsy affairs

Feet, too, need to be protected against the numbing cold of arctic conditions. At the left is a wool-lined shoe of the type worn by flyers

TEMPERATURE OF SUIT, GLOVES, AND BOOTS CAN BE CONTROLLED SEPARATELY
HEATING WIRES SEWED INTO OUTER WOOLEN SHELL
COTTON LINING PERMITS RADIATION OF HEAT TO BODY

Electrically heated suits, of which Genera. Electric is now making 12,000 for the Army, are lighter in weight, give better protection, and even cost less than the sheepskin

the propeller blades can be turned in their hub to permit change of pitch. Here, too, is a case of high and low gear. The props must be in low pitch to permit the bomber to get off the ground with its heavy war load and climb. With the blades thus set, there is less resistance and this allows the engine to rev up to full power for maximum pull. In the substratosphere, however, the blades must be set in high pitch so that they may take a bigger bite on the rarefied air. In this position, they offer greater resistance and act as a brake on the engine, preventing it from racing and thus losing efficiency.

The hub mechanisms in the electric hydromatic props permit all this to be accomplished automatically through the use of governors. The bomber pilot has merely to adjust the propeller controllers according to the number of r.p.m.'s at which his engines develop their most efficient speeds. As the plane takes off and climbs, the blades automatically move from low pitch into high and the r.p.m.'s remain the same. Thus the name, constant-speed propeller.

There remained another problem. When the bomber climbs into the rarer air, the mixture of gas and air must be leaned out to keep from having too high a proportion of fuel to air. Proper manual adjustment of mixture is so difficult as to be next to impossible for the busy pilot. A gadget called an exhaust-gas analyzer was designed on the assumption that a correct fuel-air mixture, after combustion, produces a certain percentage of carbon dioxide. This can be measured by a certain type of sensitive metal wire coiled in the exhaust manifold whose electrical resistance is affected by the CO_2 content. The mixture indicators keep the pilot informed of the slightest changes. Mixture control is essential for engine efficiency at high altitudes and also for the most economical fuel consumption.

Then there is the problem of wing design. It requires quite a bit of lifting surface to raise a big bomb load into the substratosphere, powerful motors or no. Until recently, high-lift wings were so large that they offered an incredible amount of "profile drag": heavy bombers were slow bombers for that reason. Along came Harold Davis with his revolutionary "mystery airfoil,' a design which had great lifting qualities and little drag. Bomber wing efficiency is evaluated according to lift-drag ratio.

Oxygen is fed to bomber crew members from tanks in the plane. Men in these photos belong to 1st Reconnaissance Squadron

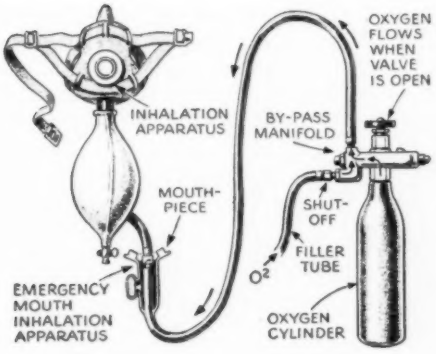
Each man regulates the flow to suit his own needs, and breathes through a face mask like the one shown at right

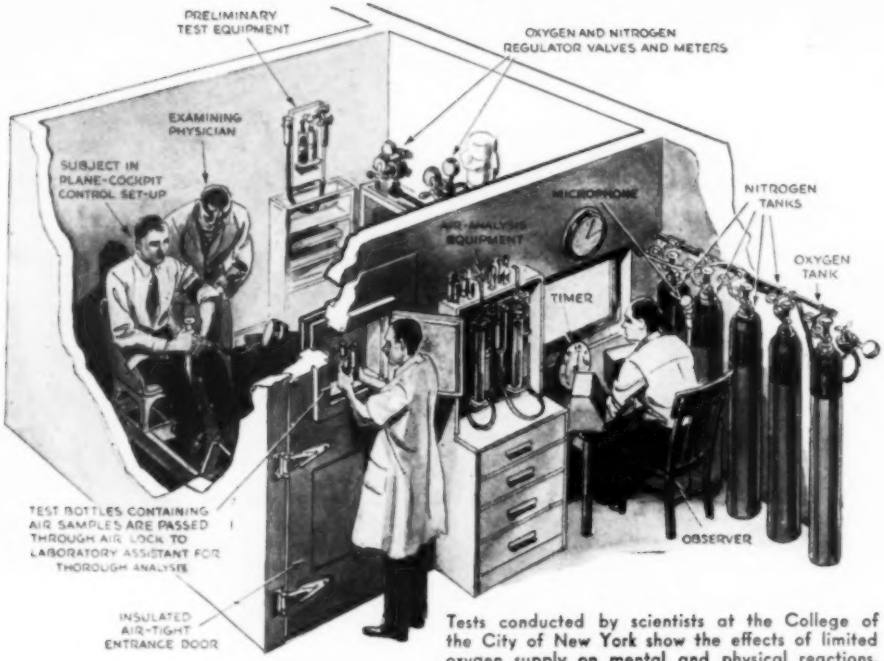
For example, the average well-designed wing has a ratio of about 13 parts lift to one part drag. The Davis airfoil astounded engineers with its 20-to-1 lift-drag ratio. Furthermore, it proved, in tests, to have 25 percent less profile drag than the average wing at low speeds and 10 percent less at high speeds.

But how about the combat crews, once these bombers reach the substratosphere? Because of the low oxygen content of this rarefied air, the life-giving element must be furnished artificially. The initial supply of compressed gaseous oxygen is carried in a flask at a pressure of about 120 atmospheres (1,800 pounds to the square inch). This tremendous pressure would prove extremely dangerous if suddenly released. Before the oxy reaches the airman it passes from the storage flask to a regulator valve or flow meter. The user adjusts the flow to suit his needs, and the oxy then passes through low-pressure rubber tubing to the face mask from which he breathes.

If, for any reason, his oxygen supply should be interrupted at these altitudes, the result would be much the same as if his regular breathing were interrupted on the ground. Within two minutes, the victim would be rendered unconscious: within another five minutes, he would be dead. Most men as physically sound as are military

MIDGET OXYGEN FLASKS are lifesavers if men have to bail out from away up. The flyer just disconnects the tube of his mask from the plane's oxygen system and hooks it to the midget flask. Without it, he might die before reaching rich air





Tests conducted by scientists at the College of the City of New York show the effects of limited oxygen supply on mental and physical reactions. The drawing depicts the set-up used in experiments

Through an air lock, a technician removes a flask containing a sample of the air in the test chamber, for a periodic check of its oxygen content . . .

. . . while an operator manipulates valves on the oxygen and nitrogen tanks to produce the exact conditions desired at various stages of the experiment

pilots and flight-crew members can function reasonably well up to altitudes of 15,000 feet. "Anoxemia"—oxygen want—symptoms include a deluding sense of buoyancy and well-being, a dulling of judgment and thought process, a delaying of reaction time, a muscular weakness, and difficulty in breathing. Tests have shown that these symptoms appear after the flyer has been at 15,000 feet, sans oxygen, for about half an hour.

Dr. W. Randolph Lovelace, Mayo Clinic researcher in altitude flying and physiology, reports interesting results of tests conducted on rats and guinea pigs in decompression chambers in which high-altitude conditions are simulated. His findings reveal distortion of the animals' brain cells from habitual exposure to rarefied air. This, he said, might conceivably account for the "queer" behavior of pilots who habitually fly to high altitudes without oxy equipment. Oxygen want, intense cold, and pressure (or, rather, lack of external pressure)

can be the cause of strange and dreadful ailments other than brain-cell distortion, however.

In 1920, Maj. R. W. (Shorty) Schroeder, in one of history's most spectacular flights, achieved a world's altitude mark of 33,113 feet. At this point, his oxy supply gave out. The thermometer indicated 67 below zero. The plane was an open-cockpit type and unheated. The Major lifted his goggles to check the oxygen, lost consciousness, and, with eyes swollen shut, plummeted to within a couple of thousand feet of the ground before being revived by the normal air density of the lower altitude. Almost blind, he miraculously landed right side up. X-rays of his heart revealed that it had expanded to three times normal size! His eyeballs were frozen and he spent some time in the hospital.

Nitrogen, that inert enemy of high-flying men and machines, contributes largely to another aerial malady known as "aeroembolism," the airman's version of the "bends" divers experience after rising to the surface of the water too quickly. Pursuit pilots, because of the rapid rate of climb of their ships, are more apt to be afflicted than the slower-climbing bomber crews, but the latter are also susceptible. When the late Big Bill Wheatley, Consolidated test pilot, took the B-24 aloft on the first high-altitude flight, a strange thing happened. He not only experienced the pain of aerial "bends" but, when he landed, the vision of his right eye was nearly gone. His sight remained this way for several days, then he flew to the Mayo Clinic in desperation. Treatment and long sessions in the clinic pressure chamber restored Wheatley's sight.

What occurs is that one's blood, tissue fluids, and joints give off, at high altitudes, their nitrogen in the form of bubbles. The breathing of oxygen replaces the "evaporated" nitrogen to some extent, but the ideal aeroembolism insurance is for the pilot to decompress himself before he goes aloft. The first experiment of this sort, under actual flight conditions, was performed on Milo Burcham, Lockheed test pilot, during the altitude tests on the speedy, twin-engined P-38. He first entered the decompression room, donned the BLB oxygen mask, and pedaled a gymnasium-type bicycle slowly for half an hour while breathing oxy. This strange procedure works off the nitrogen bubbles. He put on his flying suit, switched the oxygen supply to an emergency flask in the right leg of the suit, walked to the plane, and, immediately after entering the cockpit, connected his inhalation apparatus to the P-38's oxy tanks. Then he took off and climbed into the stratosphere, suffering no aeroembolism. From the time he entered the decompression room until he landed, Burcham breathed only oxygen. One breath of fresh air containing nitrogen would have undone all his "supercharging" efforts.

Proper diet is another defense against the strange perils of the substratosphere. A light diet high in carbohydrates is recommended by flight surgeons; pure chocolate is ideal. More oxygen is required to oxidize a fat than a carbohydrate because the fat must have extra oxy to unite not only with the carbon in the food to form carbon dioxide, but also with the hydrogen to form water. All diets must include non-gaseous foods, because at our optimum altitude of 30,000 feet, any gas in the stomach and intestines will expand to four times sea-level volume.

There is still another danger facing the high-venturing flyers. In normal life on the earth's surface, we are accustomed to a pressure of 14.7 pounds to the square inch on every part of the body. When we climb into the substratosphere, and even into the stratosphere proper—around 37,000 feet—pressure becomes practically nil. Deep-sea fish, when brought to the surface, expand and their eyes bulge because they are formed to withstand the pressures of the deep. Flyers do not behave so queerly, but their organs dilate and severe pain and damage result from the lack of accustomed pressure. The late Wiley Post used a pressure suit in his pioneering flights to overcome this condition, but the trend of development drifted toward the use of sealed pressurized cabins.

Planes are symbols of the whole defense effort in this emblem adopted by the War Department

Capt. D. W. "Tommy" Tomlinson, T.W.A.'s vice president in charge of engineering, who has probably spent more time above 30,000 feet than any other pilot, has this to say:

"The adaptation of pressurized cabins to bombers is not too difficult. Only the portion of the fuselage containing the flight crew and adjacent rest space need be pressurized. This calls for pressurizing the nose of the airplane, which is relatively safe from the effects of machine-gun fire.

"An air lock must also be incorporated so that, in emergency, gun crews may move out of the pressurized section to man their guns in the after portion of the fuselage. Oxygen must be *(Continued on page 220)*

Liquid Forging

BECOMES A DEFENSE ASSET

SPINNING at 50 to 3,000 revolutions a minute, molds laden with liquid metal at white heat are aiding industry and speeding defense. The whirligigs carry out a remarkable foundry process called centrifugal casting—employed for years in limited fields, but now branching out on an unprecedented scale. Today its variety of products includes such vital military and civilian equipment as cylinder barrels and propeller-blade bushings for airplanes; machine tools to fill the expanding needs of armament factories; gear blanks for cars, trucks, and tractors; and other indispensable items of ordnance and heavy machinery.

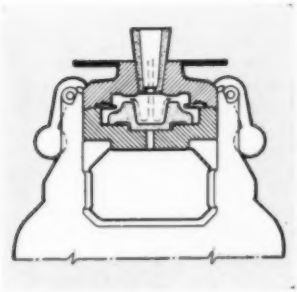
Centrifugal castings range in size from a fitting of only a few pounds up to a massive two-ton screw-down nut for a steel mill. In strength and resistance to wear, they compare favorably with forgings, which are made by hammering heated metal into something

A WHIRLIGIG MAKES GEARS

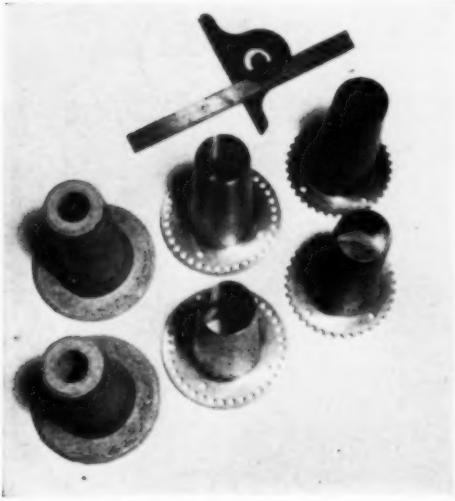
As the turntable at right revolves, 18 centrifugal-casting molds spin several hundred times each minute to turn out Ford's gear blanks for use on trucks, tractors, and cars. Just three minutes after molten steel has been poured, as above, a gear blank emerges from a hood which controls its cooling, and it is ready at once to be taken from the mold

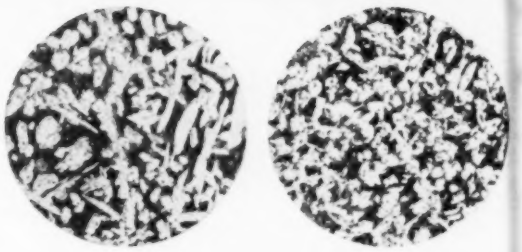
approaching the desired shape. In saving time, labor, and metal wasted in prolonged machining, they rank with less durable castings made by pouring molten metal into stationary molds.

The excellent grain structure of centrifugal castings, free from any weakening lines of metal flow, is plainly visible under a microscope. The soundness and strength-giving properties result from the tremendous centrifugal force that acts upon the contents of the mold. Because this force acts on molten metal, the process has been nicknamed "liquid forging."



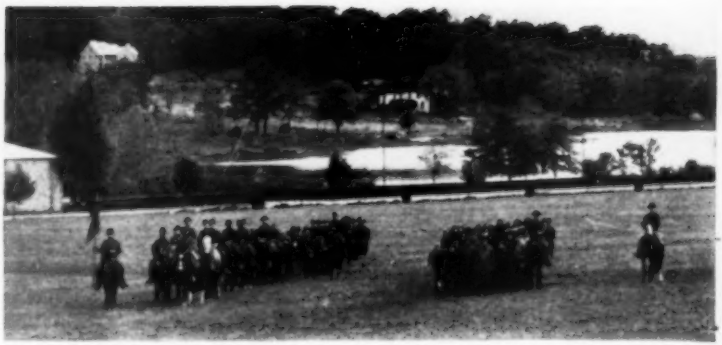
Section of Ford mold. Knobs at the sides swing out as the mold spins. The faster the spin, the tighter the knobs hold the top



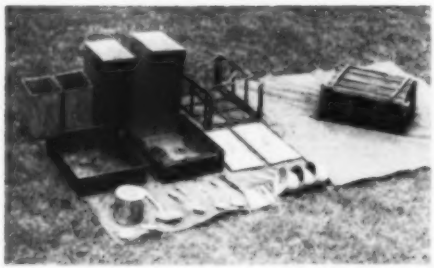


PLANES USE "LIQUID FORGINGS." Top, a modern sky fighter. Left, variable-pitch propeller-blade bushings of aluminum bronze, product of centrifugal casting. Left to right are parts just after casting, semi-finished, and completely machined. Immediately above, the photomicrographs reveal the coarse grain of aluminum bronze cast in a stationary mold, and the uniform, small grain of the same alloy, with greater density and strength, brought about by centrifugal casting. Each view is magnified about 60 diameters. The photomicrographs and photo of the bushings are reproduced through the courtesy of Ampco Metal, Inc.

A battery of the U. S. Army's 99th Field Artillery Battalion (Pack) in review formation. In the battalion are three howitzer batteries of four guns each, with one headquarters battery and one service battery



MULES CARRY GUNS WHERE TANKS



Field stoves (mountain-artillery type) and kitchen equipment to cook food for 150 men are carried in two loads on one mule. Each load is "mantied up," or wrapped, in a "manta"—a piece of canvas—before it is lashed in place. A two-load pack of this type is held on the cargo-type Phillips packsaddle with a hitch called a single diamond. One-load packs take a squaw hitch, triple loads a double diamond

TANKS have plenty of speed and fire power when the going is good, but they don't have the legs and feet which they would need to work their way into mountainous or jungle country, where every tree and rock is a potential tank trap. So the Army is busily building up pack-artillery outfits to carry its guns into otherwise inaccessible spots.

Mules have been found to be the best animals for this work. They are used for hauling guns, ammunition, and supplies, and also as riding animals. Only a few horses are used; some for mounts for officers, the others as bell mares. The latter animals, each wearing a bell with an individual tone, are assigned to groups of mules. Through training the mules learn to recognize the tone of the bell of their group, and they follow the bell mare, which is led.

Training mules and men for pack-artillery work takes months of hard work, because

Part of the signaling equipment of a pack-artillery outfit. Wire can be unrolled as the mule walks

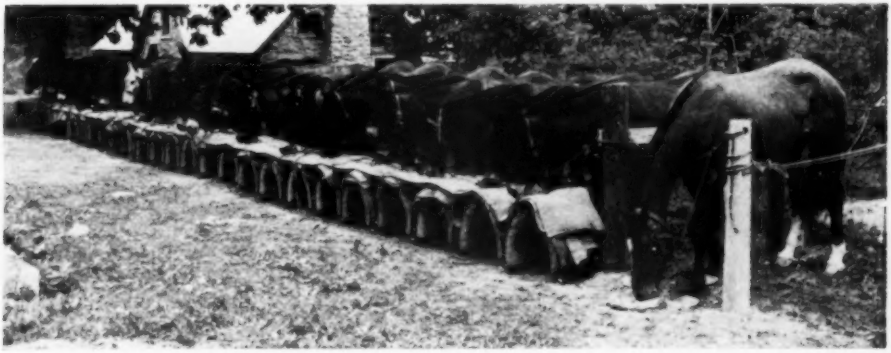
CAN'T GO

both must be letter-perfect in their jobs. Mules must learn to stand still when being loaded and to follow the bell mare. Men must be taught the intricacies of loading a mule properly so the load won't chafe or fall off. (Some mules know when a load is not properly adjusted, and won't move until it is fixed.) The men must learn how to unload, assemble, and fire the 75-mm. howitzer, which is the pack artillery's principal weapon, so they can do it blindfolded, on top of a rock pile, or in the middle of a swamp.

In the end the Army has in its pack artillery a good old-fashioned team of men and mules, with modern war equipment, that can do the job in the most difficult situations. (CONTINUED)

You can talk about mechanization, but when it comes to a mountain or jungle job, they still call for the Army mule

Packsaddles double as feeding troughs when the mules are in the "park." It takes a lot of training to make a good pack animal. They must learn to stand still while loaded and to follow the right bell mare



PACKING THE MULE

1 With ammunition in "clover leaves" (three rounds in a bundle), two side and one top load are carried; when it is loose, two side loads of five rounds each are "mantied up"

2 Here the manta is being wrapped around the load. This procedure is called "mantiing up." The heavy canvas protects guns, ammunition, and other equipment from dust and from rain that would cause metal parts to corrode

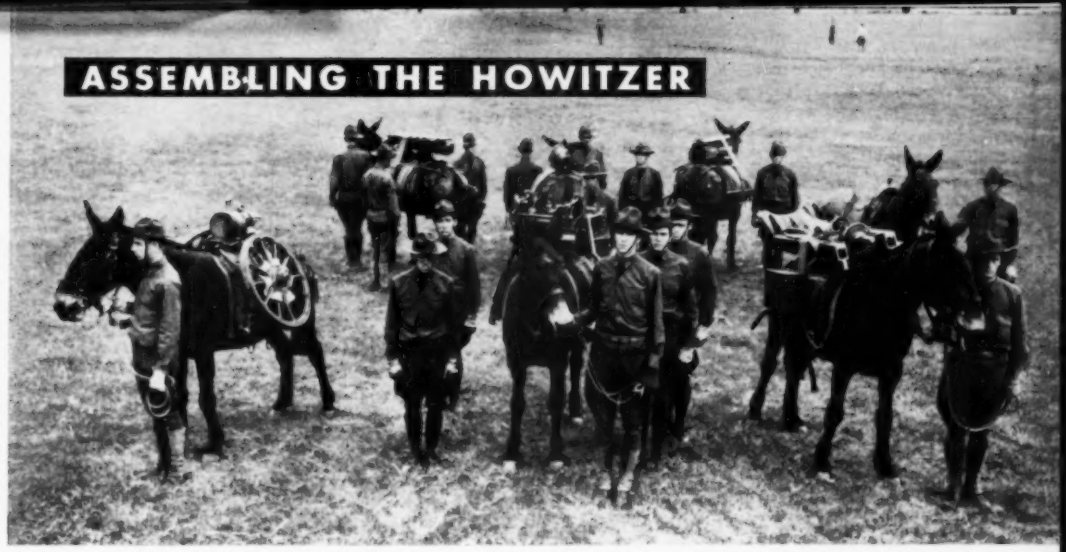
3 Three loads of ammunition wrapped in their mantas. Each load is held together with a lair rope or sling rope, a piece of ⅜-inch manila 25 feet long, tied in three half hitches

4 Side loads are put on first. If they are of equal weight, they are balanced opposite each other. If one is heavier than the other, it is placed higher on the saddle. Ropes hold the side loads in place while

5 . . . the top load is added. The normal pack is two side and one top load of three rounds each, or two side loads of five rounds each

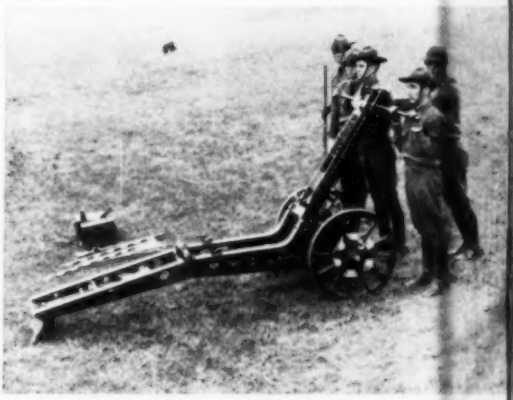
6 Tightening up the 50-foot, ½-inch manila lash rope that holds the pack on the saddle. The slack is taken out of the double diamond to make the "hog tie"

ASSEMBLING THE HOWITZER



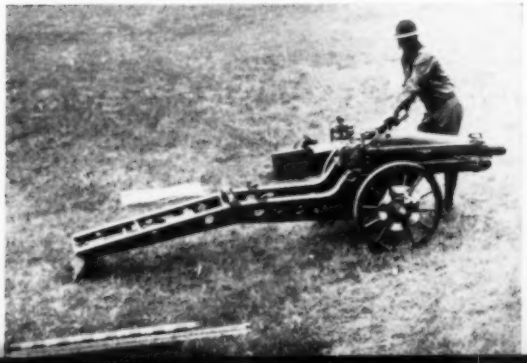
1 Six mules divide the job of carrying a 75-mm. howitzer. One carries the wheels and breech; a second, the "tube," or barrel; a third, the rear half of the trail; a fourth, the front trail; a fifth, the "bottom sleigh" and the recoil mechanism of the howitzer; and a sixth, the gun cradle and the "top sleigh." This is the arrangement in which the animals are placed when the gun is to be packed or unpacked

2 With the mules placed as in the photo at top of page for unpacking the gun, the front and rear trails are first taken off and fastened together. Then the wheels are unloaded and slipped onto the axles



3 The cradle is then unpacked and carried to the parts already assembled by means of a pair of lifting bars. Locked in place it is ready to receive the bottom part of the sleigh

4 Now the gun breech is placed, followed by the tube and the top sleigh. Every move of the men is prescribed, and they move on signal like a football team



5 Ready for action. Men have been drilled at their job until they can unload and assemble their gun blindfolded on any kind of ground

On a realistic sea of cement a destroyer squadron, composed of a leader and two divisions of four ships each, carries out a patrol assignment in search of enemy craft. Note the realistic wakes behind ships

Norman Bel Geddes, creator of the Lilliputian fleet, applies a ruler to one of his model ships. All the vessels are made to an exact scale of one inch equaling 100 feet

PHOTOGRAPHS BY
NORMAN BEL GEDDES STUDIOS

MODEL SHIPS

THE ONLY five-ocean navy in the world, which has taken seven years in the building, assembling and equipping, now lies ready for any kind of naval engagement involving any number or combination of numbers of the principal naval powers—the United States, Great Britain, France, Germany, Italy, and Japan. It comprises not only the fighting ships, submarines, destroyers, aircraft carriers, light and heavy cruisers, and capital ships, but such auxiliary vessels as mine layers and sweepers, tugs, tenders, barges, and depot ships, and a collection of merchant vessels that range from the *Queen Mary* to a Chinese junk.

This huge fleet adds up to more than 1,700 vessels of all types and descriptions. Its admiral is Norman Bel Geddes, industrial and stage designer and streamliner of the circus, who is by way of being a naval tactician of parts and sometimes spends his spare hours in sea battles with American naval officers he numbers among his friends.

The five-ocean navy consists of models of all the fighting craft listed in Jane's Fighting Ships, the foremost source book of naval vessels, and such other source material as Mr. Geddes can acquire. The ocean on which they move is a 20-foot square table of cement, built at a cost of $1,500, and irregularly raised to simulate mid-ocean conditions, with smooth areas representing inlets and bays.

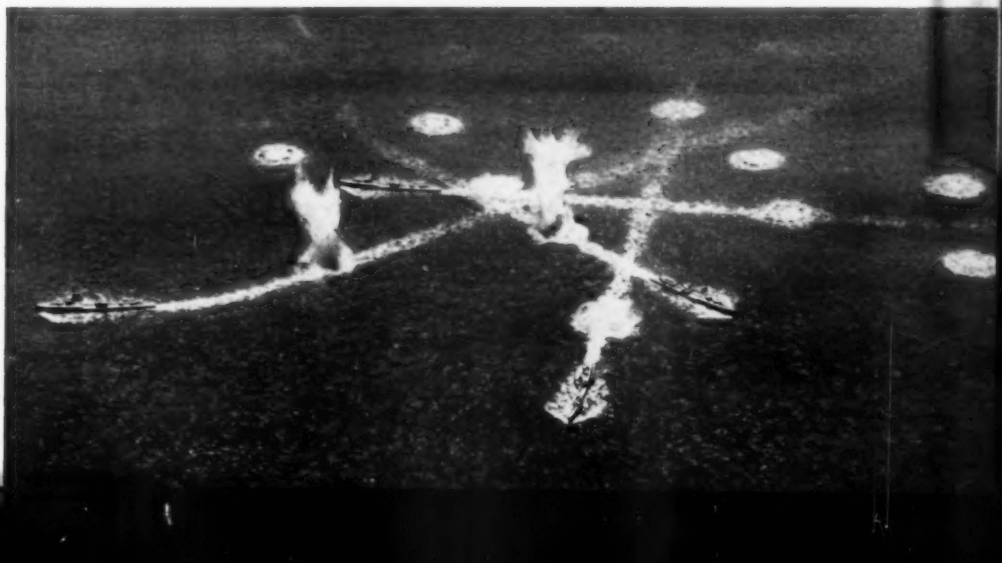
The hulls of the ships are made of brass and the superstructure, armament, and planes are

This is only an infinitesimal part of an armada of more than 1,700 scale-model ships, representing the war vessels of the six principal naval powers of the world, with auxiliary craft and some merchant ships

SHOW WORLD'S NAVIES

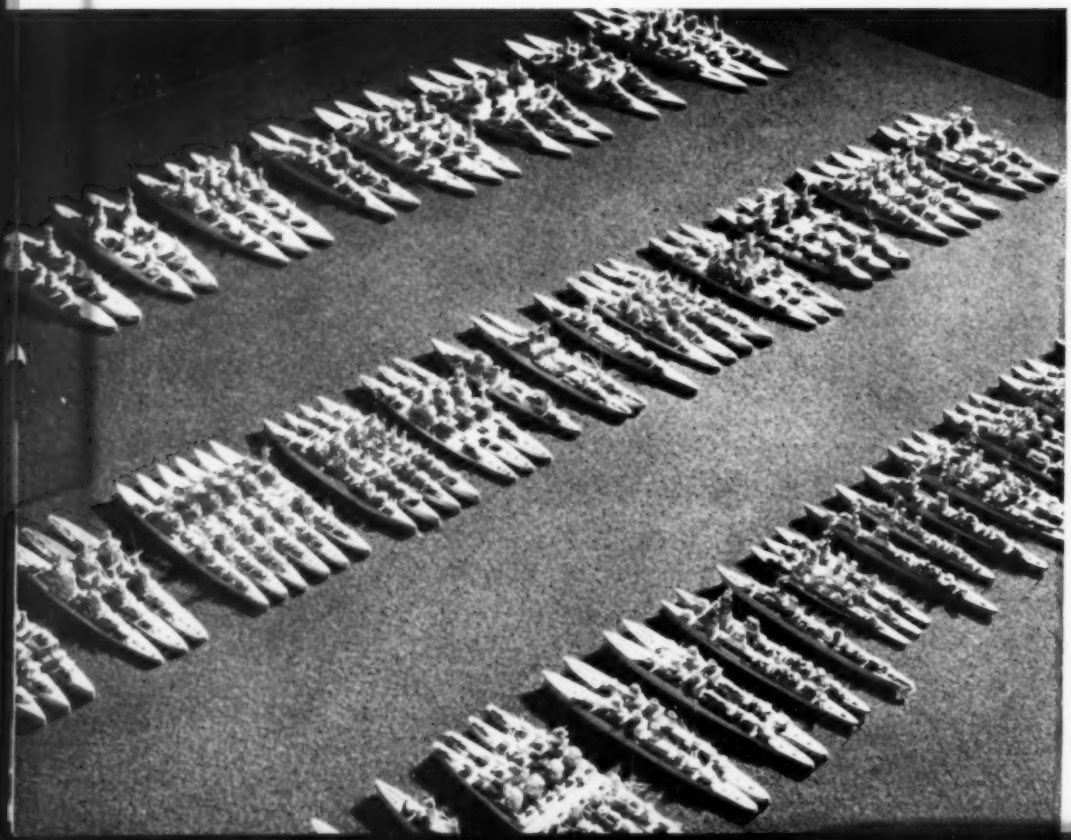
also of brass. All the models are to exact scale, with one inch representing 100 feet. The *Queen Mary*, largest of the merchant vessels, for example, is $9\frac{5}{8}$ inches long, with a beam of $1\frac{1}{8}$ inches and a height, to the top of her stacks, of $1\frac{1}{2}$ inches. The largest of all submarines, the French *Surcouf*, is $3\frac{1}{2}$ inches long. The British battleship *Nelson*, of the *Rodney* class, with three forward turrets of three 16-inch guns each, is 7 inches long, and has a beam of $\frac{7}{8}$ of an inch. Her big guns are about $\frac{3}{8}$ of an inch long. The naval barges are $2\frac{1}{4}$ inches long and the small river tugs are tiny things, of 1 inch in length or less. The fleets are complete as of the outbreak of the war. They lack the newest warships, such as the great *North Carolina* and *Washington*, recent additions to the United States capital ships. These are about to be added to the collection. The navy and its oceans have a value of several thousands of dollars. [CONTINUED]

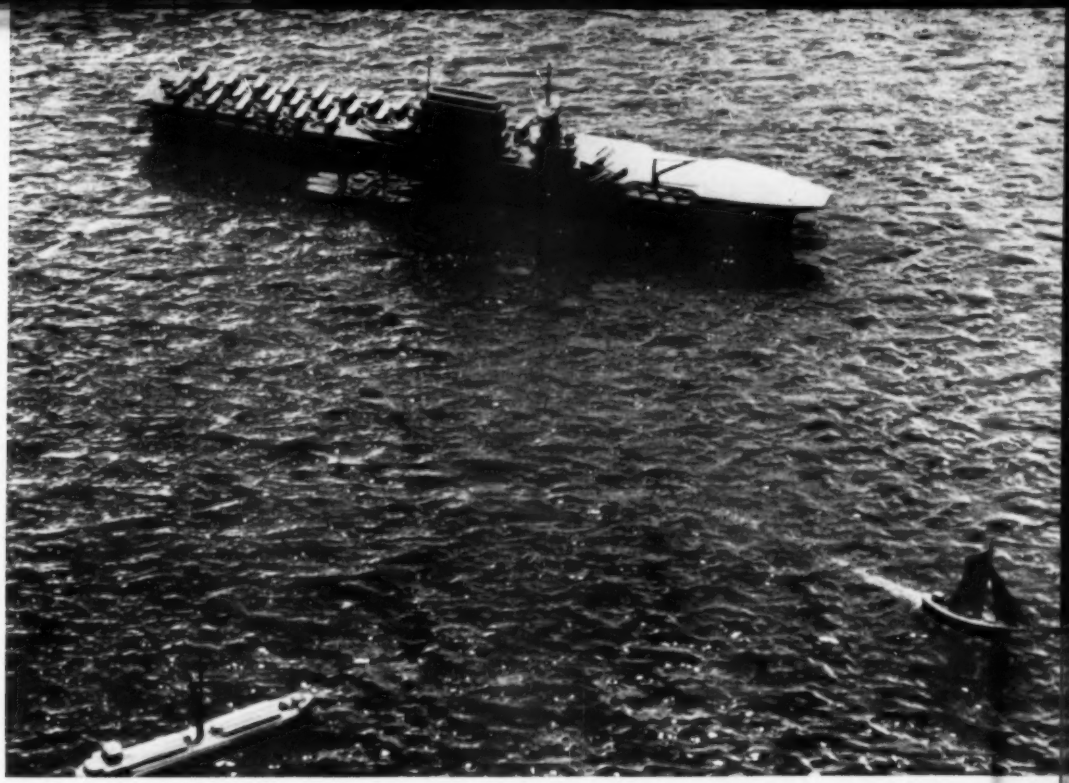
Periscope sighted! Four destroyers on convoy duty dash in for the kill on the report of a submarine On crisscrossing paths, they drop depth bombs on all sides of the spot where the periscope appeared



Ships of war and peace at anchor in a busy roadstead. Beside some of the larger vessels are tiny tugs or tenders. In the center foreground is a merchantman taking on supplies. The ocean is 20 feet square

Fighting ships of the world: The only war vessels of the major powers not represented are the very newest additions such as the great U.S. battleships North Carolina and Washington; these will join the fleet

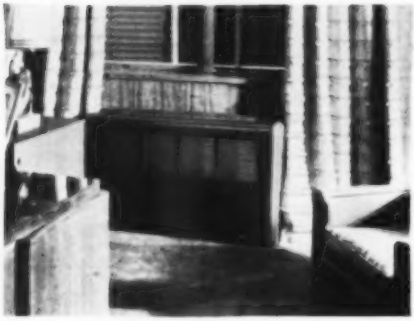




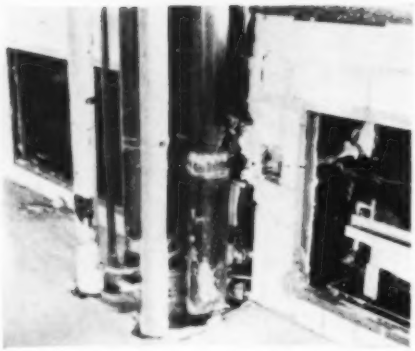
Here is the model of the U.S. aircraft carrier Lexington, with her planes nestling on her deck and three tenders hugging her huge side. In the left foreground is a naval tanker and at the right a tiny sailboat

A naval depot ship, at right, above, serves two destroyers, while a light cruiser takes on stores from a tender. Below, merchant ships zigzag along with a convoy of cruiser, destroyers, and mine sweepers

Pressure Air-Conditioning Systems Use Smaller Ducts



USING compressed air, carried at high velocity in conduits six inches or less in diameter, instead of blowers and large ducts, has made possible air-conditioning systems which can be installed in little more space than was formerly occupied by heating systems alone. Particularly suitable for tall buildings, new or old, these systems wash, humidify, and compress the outside air in a central basement unit. Emerging from the pipes in each room, the air passes over coils through which hot or cold water may be circulated. Thermostats on these coils, by controlling water flow, maintain any desired temperature in each room.



Its parts inclosed, a cabinet like the one above sends hot or cold conditioned air into each room. Thermostats enable each to be kept at desired temperature

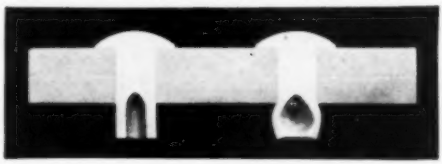
Riser group at left consists of air and water supply, water return, and drain. Hot and cold pipes, drain, air conduit, and take-off shown in section at right

Self-Setting Explosive Rivet Speeds Warplane Building

EXPLOSIVE rivets, set off by heat applied to the rivet head with an electric "gun," are proving highly effective in speeding metal plane construction. Each rivet has a minute quantity of a high explosive in a cavity in its shank. The force of the explosion can be so accurately controlled that the resulting expansion of the rivet shank can be held within limits of .02 inch. Used in "blind" spots, where only one end of the rivet is accessible, they can be set at the rate of 15 to 20 a minute, as against two to four a minute for the old-style blind fasteners. There are about 900 blind fastenings in an all-metal pursuit plane, and 10,000 in a large bomber. In spite of their explosive nature, the new rivets are said to be safe to handle. Tests have indicated that they are insensitive to shock and friction.

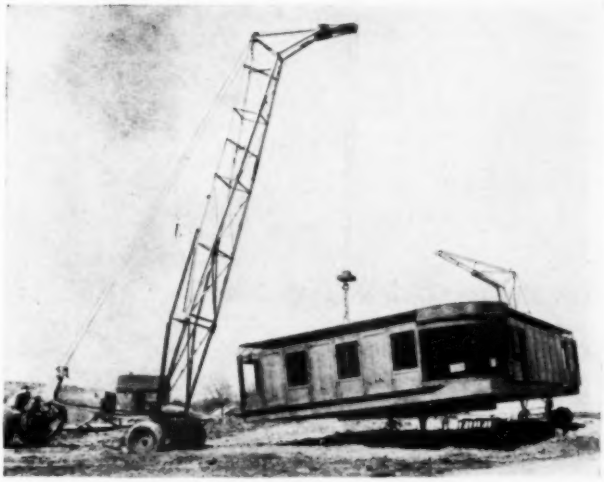
Action of blast in end of shank to form head

Above, setting rivets by electricity and a minute charge of high explosive. Sections below show a rivet before charging and one after its explosion

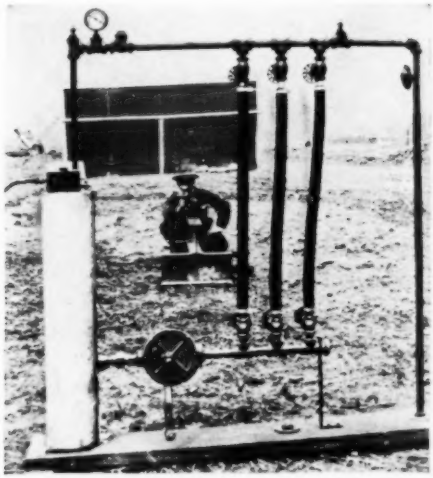


Building Is Welded into Unit and Then Moved to Its Site

BY USING arc-welded steel exclusively in the construction of a new radio station at Toccoa, Ga., R. G. LeTourneau, the builder, has been able to create the structure as a single unit. After completion at the LeTourneau plant, the building was hauled approximately three miles by means of a truck-trailer crane and deposited on the site it will occupy. In fabricating the unusual structure, arc-welded box-panel building sections were used. Such steel building blocks are made by pressure-stamping 12-gauge steel sheets and welding them together with interior spacers set at intervals of not more than 24 inches. These blocks, or panels, are then arc-welded together to form the structure. Such construction is said to be applicable to any type of building from a small private dwelling to a large industrial plant. The simplicity cuts building time in half.



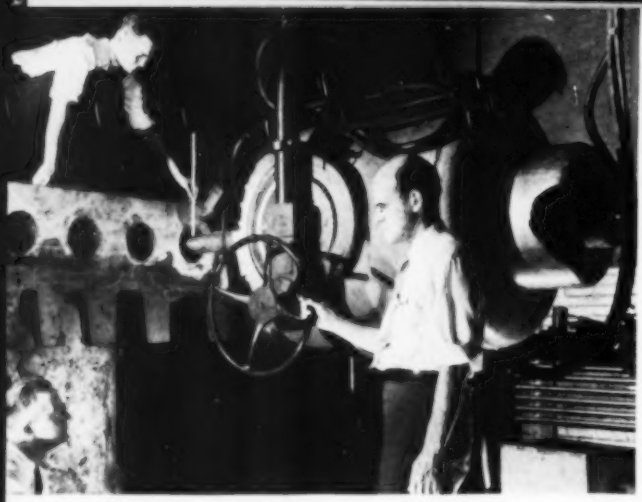
Built entirely of welded steel blocks, radio station WRLC is hauled three miles along a Georgia road to its site, where it is set on its foundation and roofed. The builder cut construction time 50 percent



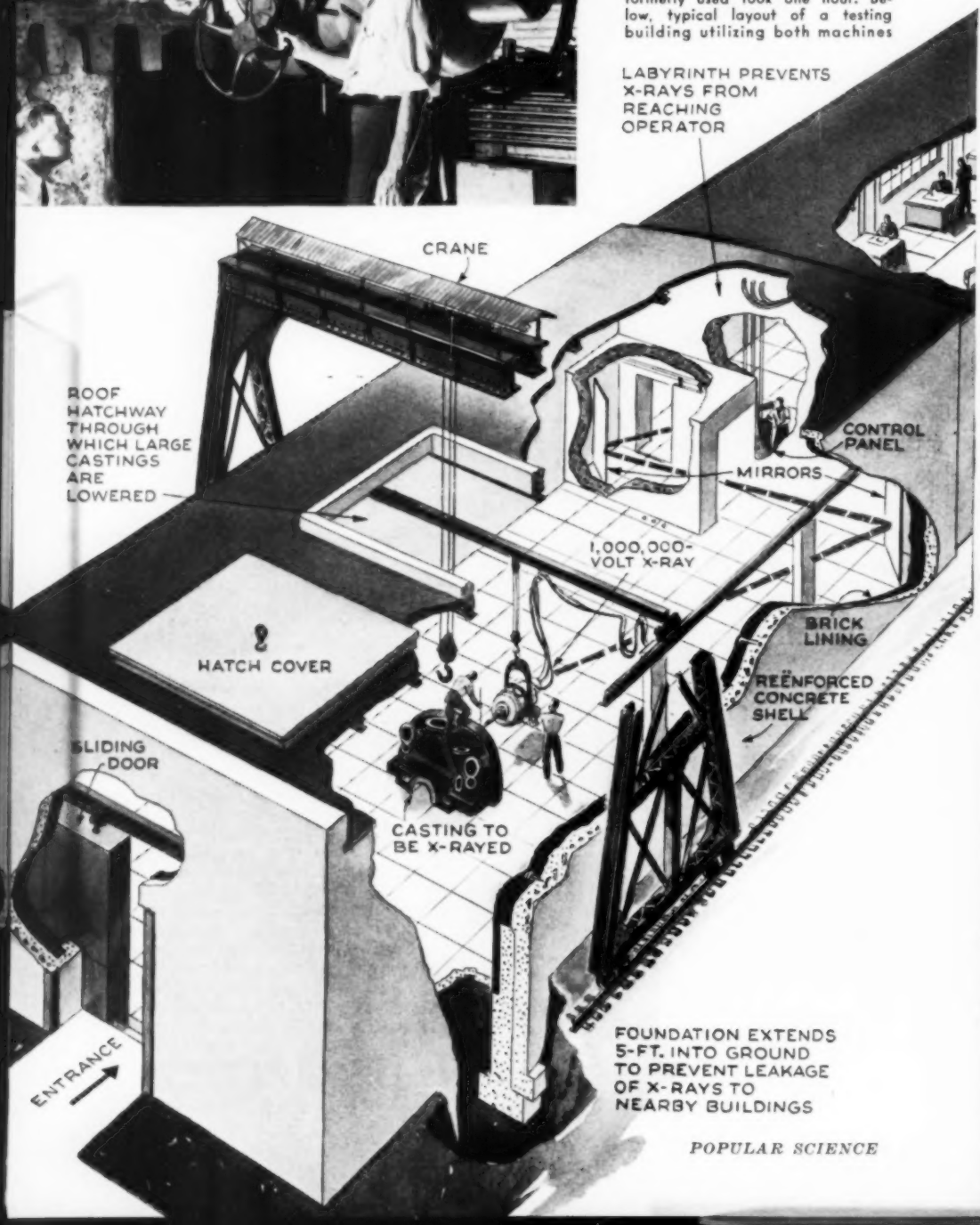
Firing machine-gun bullets through a new rubber hose causes no break in the plane fueling system of which it is part. Its lining is self-sealing

Lining Will Seal Bullet Holes in Bomber's Fuel System

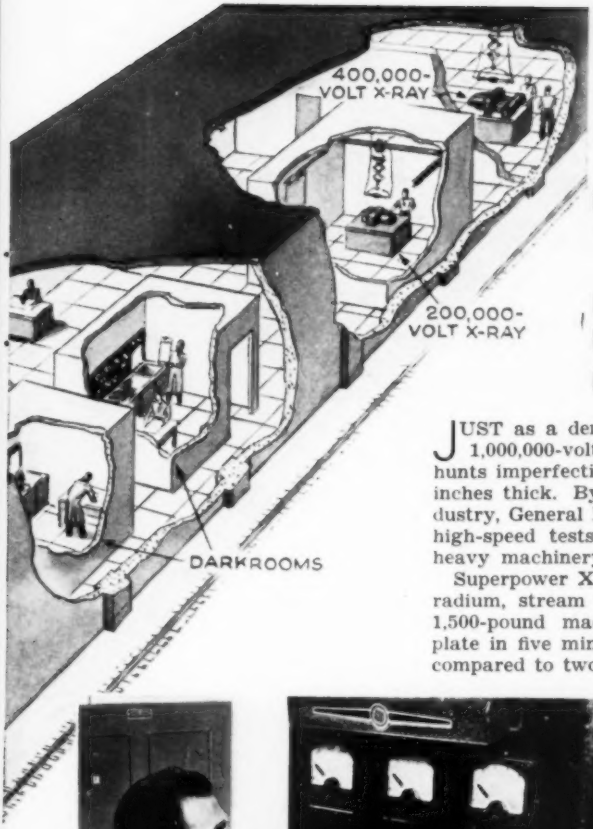
FIVE times, in a recent test, 50-caliber machine-gun bullets ripped through a new-type rubber hose, and each time the tube sealed itself and prevented the fluid within, flowing at a pressure of from ten to 15 pounds, from escaping. Designed for use in bombing planes, the hose is lined with a synthetic rubber, highly resistant to gasoline and oil, that closes punctures as fast as they are made by gunfire. Besides protecting fuel lines from machine-gun fire, the new self-sealing hose eliminates the necessity for carrying auxiliary metal fuel systems, thereby decreasing weight and increasing the useful load of bombing planes.



Being made ready to test a heavy steel casting for imperfections, the 1,000,000-volt X-ray unit, at left, will do the work on a plate four inches thick in less than two minutes, whereas the 400,000-volt type formerly used took one hour. Below, typical layout of a testing building utilizing both machines



POPULAR SCIENCE

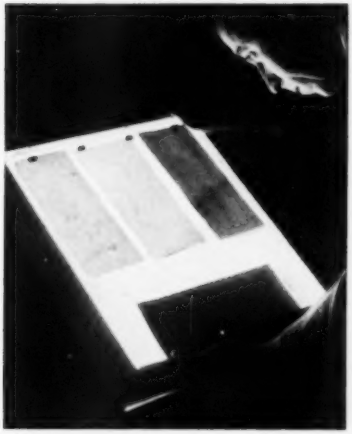


1,000,000-Volt Testing Tool

Powerful X-ray machine saves hours in hunting flaws in steel plates up to eight inches thick

JUST as a dentist seeks hidden flaws in your teeth, a 1,000,000-volt counterpart of his X-ray machine now hunts imperfections in massive steel castings up to eight inches thick. By far the most powerful ever used in industry, General Electric instruments of the new type give high-speed tests to turbines, marine boilers, and other heavy machinery vital to industry and defense.

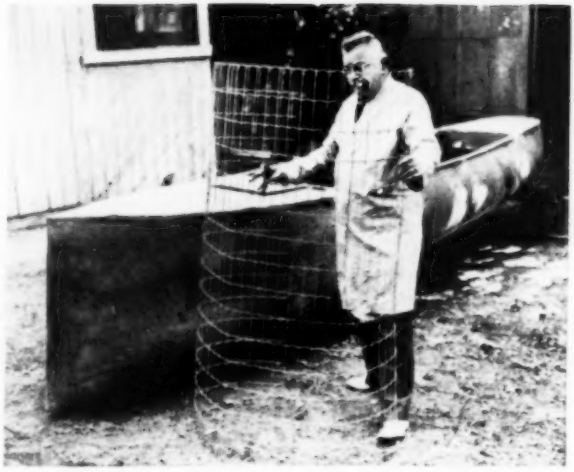
Superpower X rays, equivalent to $90,000,000 worth of radium, stream from the "nozzle" of the barrel-shaped, 1,500-pound machine. They radiograph five-inch steel plate in five minutes, and three-inch plate in 48 seconds, compared to two and a quarter hours for five-inch plate, and two and a half minutes for three-inch, the fastest previous time. Every person must leave the test room. Technicians wear wrist straps containing X-ray film as a check against an overdose of radiation. Escape of the rays outdoors is prevented by walls of brick and concrete more than two feet thick, having an 18-inch concrete door, incased in one-inch steel and operated by a motor hoist.



At the control panel of the powerful testing machine, the operator above is shielded by a two-foot concrete wall from any harmful effects of the rays. At right, the developed X-ray picture may reveal flaws that would cause breakdowns while in service, thus saving industry thousands of dollars

Rock Compound and Wire Used to Build Boat

WITH a foundation of wire netting, a "boat of rock" has been produced by Dr. Christian Paul, a chemical engineer, of Los Angeles, Calif. The craft was constructed to prove the strength of a rock compound he developed. Over a wire-netting skeleton, Dr. Paul smeared the cement-like composition, smoothing the exterior with a stiff-bristled brush. The whole job required 40 hours, five of which were consumed in letting the water evaporate from the mixture.

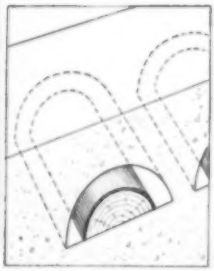


Wire netting was the base used for the odd boat in the background

Typewriter Practice Board Makes Touch System Easy

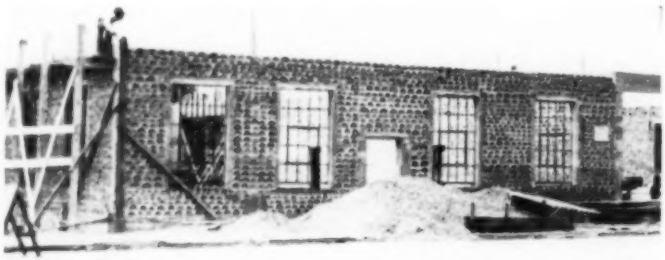
AS AN AID to perfecting touch system in typewriting, a new practice board is equipped with openings, each representing one key of the typewriter and each equipped with a movable slide. In practicing with the device, the typist flips down the slides with his finger tips as he touches the openings. The characters revealed below show him whether or not he has been striking the correct keys.

Cottonwood Blocks in Concrete Insulate Wall



Using cottonwood blocks and concrete as if they were bricks and mortar, the WPA found a strong and well insulated type of construction as shown in the diagram above and the photo at right

COTTONWOOD blocks, cut from green logs and laid in the wet concrete of a new WPA warehouse at Bismarck, N.D., provide a novel type of insulated wall. After the concrete had set, the green wood dried out and shrunk, leaving in the concrete air spaces which increase its insulating properties. The logs used were from six to 12 inches thick, sawed, and split once. The blocks were laid in the concrete an inch and a half apart.



For the familiar runaway scene, a wheel can be kicked off the careening stagecoach by means of the arrangement shown below

Inventions Add Thrill to Western Movies

NEXT TIME you see a hard-riding cowboy risking his neck in a western thriller, just remember that he is probably using an invention or two that the camera doesn't catch.

That does not mean that he isn't taking plenty of punishment, because a lot of hard and dangerous work goes into making the "horse operas." But the actors and stunt men who pack them with action have a whole bag of tricks to lessen the hazards of their work and at the same time make better pictures.

When they want to upset a wagon or a stagecoach, for example, a husky spring is rigged so that when the driver pulls a cord it will shove a wheel off its

When the driver operates a release, a spring and a plunger shove the wheel off the axle, causing the vehicle to pile up dramatically in front of the camera

For jumping from a running horse to a rocking wagon or stagecoach, Johnny Mack Brown, western star, uses the platform stirrup shown above. This enables him virtually to step from his mount onto the vehicle. It cramps one leg in riding, but safety is worth that

axle and dump the vehicle right where it is wanted—in front of the cameras. Or maybe a tripping device will be used to release the wagon tongue, with an airplane shock cord hooked between the axles to cramp the front wheels when the tongue pulls out.

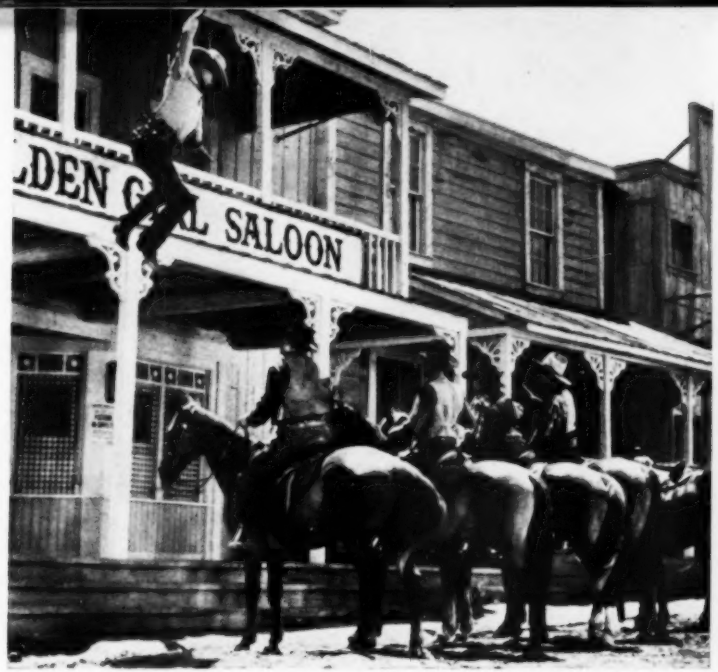
By knowing when the spill is coming, the driver can give the other actors a signal so they can jump clear at the proper instant and hit the ground before the wagon has time to roll over on them.

Open step-type stirrups are often used so a rider jumping or falling from a horse will not get his feet caught and be dragged along the ground. For leaps from one horse to another platform stirrups, with one higher than the other, enable the rider to give himself a good boost as he jumps.

Johnny Mack Brown, a star of the westerns who gained national fame 15 years ago as a halfback at the University of Alabama, wears football shoulder pads under his silk shirt when he is riding for a fall, plus sponge-rubber knee and elbow pads. Worth Crouch, a 25-year-old stunt man who was a *bona fide* cowboy until three years ago, uses flat-heeled, rubber-soled shoes to cushion his falls, and tops them off with slide-fastened leather uppers

1 Here's another way to wreck a wagon: the tongue is fastened to the body by means of a metal breakaway with a trigger that is operated by means of a long cord

2 When the cord is pulled, the powerful spring yanks the jaws of the tripping device apart, letting the tongue pull out



Leaping off a balcony onto a mounted horseman or the ground below can be hard on the feet and legs. So stunt man Worth Crouch wears flat-heel sneakers with thick rubber soles for such jobs. To make them look like orthodox cowboy boots, he puts on slide-fastened leather uppers as shown at the right, above. Sponge-rubber knee pads concealed under the trousers also help to cushion the shocks in these thrilling scenes

that give him the appearance of wearing cowboy boots.

When a fast-moving cowpuncher is suddenly yanked from his horse by a well-thrown lariat, it is likely that he will land on a spot of ground previously spaded to soften it. And if the saddle comes off with him, it is because it has easily released fastenings. Probably a rubber saddle horn is used too, to prevent injury to the rider.

The camera doesn't catch all the devices and tricks that are used, but if you watch closely when the hero in a western looks as though he is headed for sure and sudden death, you may spot some of them.

A "driverless" team can be controlled by concealed reins through a hole cut in the front of the wagon

3 At the same time, an elastic cord cramps the wheels and throws the wagon into a sharp turn. Here this part of the set-up is tested on a buggy before use in a scene

4 And this is a result: The vehicle piles up in a cloud of dust right in front of the camera while the team gallops wildly on

Book Review

ANIMAL LEGENDS AND FACTS. Without spoiling good stories by skepticism, "The Lungfish and the Unicorn" (Modern Age Books) quotes highlights of what has been written on such fabulous creatures as the dragon and basilisk. Sea serpents slither through its pages. Unicorn myths prove to date from 398 B.C. But even stranger creatures actually exist, the author points out, in the lungfish, the giant panda, and the okapi.

ADVENTURE IN THE AIR. Fourteen aviators and their biographies appear in "Famous American Flyers" (Thomas Y. Crowell). They include the Wright brothers, Glenn H. Curtiss, Edward V. Rickenbacker, Albert C. Read, John Rodgers, Richard Byrd, Charles A. Lindbergh, Amelia Earhart Putnam, Frank M. Hawks, Wiley Post, Edwin C. Musick, Howard Hughes, and Douglas Corrigan.

NEW HORIZONS IN GARDENING. Striking modern aids to amateurs and professionals are described in "Science in the Garden" (Duell, Sloane & Pearce, Inc.). How to make a flower bed last 12 years, produce hybrids, grow seedless tomatoes, and use colchicine, are among a myriad of suggestions.

If your bookseller cannot supply the book you want, order from Book Department, Popular Science, 353 Fourth Ave., New York, N.Y.

Question Bee

In one of the book reviews above, 14 famous American aviators are named. Can you pick the right name from the list to complete each of the sentences below? You will find the correct answers on page 224

1 ——— made the first Atlantic crossing by air, in the Navy flying boat NC-4.

2 ——— is famous not only for aeronautical exploits, but also for collaboration in medical research with Dr. Alexis Carrel.

3 ——— pioneered in flying transocean air routes for the clipper planes of Pan-American Airways.

4 ——— had his pilot's license suspended for a "wrong-way" transatlantic flight.

5 ——— was one of America's foremost breakers of transcontinental speed records.

6 ———, with four companions, circled the globe in less than four days.

7 ——— designed the first seaplane.

8 ———, leader of an early Navy attempt to fly from California to Hawaii, was dramatically rescued after being forced down at sea.

9 ——— was America's foremost flying ace in the first World War.

10 ——— first launched an airplane with a catapult.

11 ———circumnavigated the earth in a seven-day solo flight.

12 ———, lost in mid-Pacific flight, was vainly searched for by a naval aircraft carrier and its planes.

13 ——— was the first to fly over both North and South poles.

AUTOS

Sure-Fire Ways to Lengthen the Life of Your Car (NEXT PAGE)

Keeping Your Car Young

By WALTER E. BURTON

When applying rust preventer to chrome, let some penetrate any seams, then wipe it off the enamel

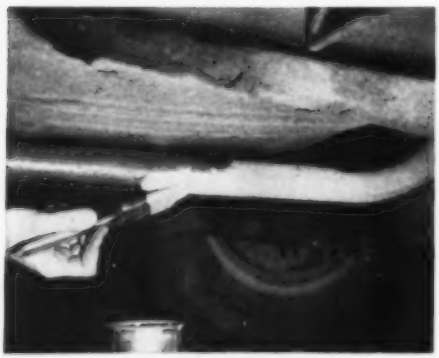
Rubber putty, available in colors, should be worked into body joints and openings under the rain gutters

LOOK over your car from bumper to bumper, from topside to bottom. Also, take a look at your neighbor's car, or those in any parking lot. Unless they are brand-new, they will all have one thing in common—rust!

It may take close scrutiny to see it on some of them, but it will be there if you look hard enough. Most of it can be removed. More important, you can prevent it from forming again with the expenditure of about as much time as it takes you to drive 200 miles. You will add both miles and months to your car's life, simply by safeguarding important metal surfaces against corrosion caused by rain, damp air, sea air, and the harmful chemicals—salt and calcium chloride—placed on highways to melt winter ice.

Most of the danger spots are readily accessible. For example, the junction of the chrome trim and paint on your head, cowl, and tail lights; of body panels and fenders or running boards; of rear license brackets and trunks or fenders. Others, such as the undersides of fenders, the exhaust pipe and muffler, and the battery case, all exposed to damage from water, dirt, flying stones, and chemicals, are harder to get at. But your efforts to rustproof them will be well rewarded.

Around the front end, chromium finish should first be cleaned with a damp cloth, dried, and then treated. The treatment may consist of a coating of good car wax. Any of several kinds of rust-preventing oil, of



New exhaust pipes and mufflers soon rust, but can be protected with a smooth-finish, bake-on enamel

Clean your battery hanger, coat it with asphalt-aluminum paint, let dry, then treat with rust preventer

the kind sold for home workshops, make good protectors for chrome plate against salt air and street chemicals. Thin when applied, such oil partially evaporates to leave a hard, tough film. Kerosene or carbon tetrachloride will remove it when desired. Clear varnish and lacquer also protect chrome, but you'll probably find that they scrape off too easily.

Between the steel top and the gutters that run from the windshield to the rear quarter panel of most cars there is a continuous crack into which water, dirt, and salt can work to pit the paint and start rust. By filling this crack with a sealer such as rubber putty, the corrosive agents can be kept out. Rubber putty comes in a number of colors. Since it never sets completely hard, it withstands vibration, making it particularly useful for filling any metal-to-metal joints around the running boards, fenders, and cowl. It will stick to almost any surface that is free of grease and water.

A good waxing makes car finish last much longer and helps inhibit rust around moldings and trim. It also makes a car easy to dust and to wash

New mufflers and exhaust pipes rust quickly, and dangerous leaks may develop in time. Their life can be lengthened appreciably if they are painted with a smooth-finish, bake-on enamel. This enamel dries hard at ordinary air temperature and additional heat makes it still harder. Of course, the surfaces to be treated should be free of rust, and the job is most easily done on new parts before they are installed.

A weak point on many cars—the storage-battery hanger—which corrodes readily, can be improved by applying rust-preventing compound to the metal surfaces. Remove the hanger and first swab it with a solution of ordinary washing soda (sodium carbonate) to neutralize the acid. Rinse with hot water, and dry. Then apply your rust preventer liberally. If the hanger already has a tarry coating which has worn through in

Apply rust preventer to the fabric strips separating fenders and body panels, then wipe off excess

Seal your tail-light lenses with rubber putty to prevent water from entering and rusting the parts

Sealing compound under fenders and on wheel panels adds life to those parts and makes driving quieter

License-plate and other mountings should be daubed with rust preventer. Keep oil off rubber fittings

spots, remove it first with a lacquer thinner and either apply the rust preventer directly or give the metal a preliminary coat of asphalt-aluminum paint.

The rust preventer also makes an effective treatment for the fabric filler strip found between the fenders and body panels of most cars. Because this material holds moisture, it exposes metal to rusting for hours after the rest of the car is dry. The rust preventer penetrates the fabric and soaks down into the joint, not only retarding corrosion, but stopping many body squeaks. Any excess oil should be carefully removed.

Fittings that hold tail-light assemblies and license brackets are seldom tightly sealed. Or you may find a supporting bolt which water can follow into the luggage compartment where evaporation is slow. Lenses in your rear lights frequently allow water to enter. Seal up all such openings with the rubber putty.

A well-tightened bolt, properly equipped with a lock washer, does not have to rust in order to hold. Rust may prevent its removal without breakage. Apply rust-preventing solution to your license-plate bolts and see how easily you change license plates the next time.

The underside of your fenders, as well as the body panels and skirts next to your wheels, is factory-finished to prevent rust. These surfaces, however, begin to present a rust problem when flying stones have chipped pieces of the original finish away.

First, remove the wheels, tighten all bolts and nuts holding the fenders and panels, and clean mud and tar from the surface, using soap and water and a stiff brush. Stubborn lumps of road tar will give way to tar-removing compound. Next, apply one or more coats of sound-deadener and sealer, which you can obtain from most retail automotive supply houses at about $1.75 a gallon. It can be put on with a stiff brush. A layer at least a sixteenth inch thick is desirable where stones are apt to strike, but you will find the substance builds up rapidly and dries quickly.

Care should be taken not to get the deadener on moving parts, such as steering gear, king-pins, knee-action joints, and rear spring shackles. Two gallons of the material should be ample for the average car's fenders and sheet-metal underparts. The treatment not only prevents rust, but should make your car quieter, since it will remove many squeaks and check the transmission of road noises and tire rumbles to the driving compartment of your car.

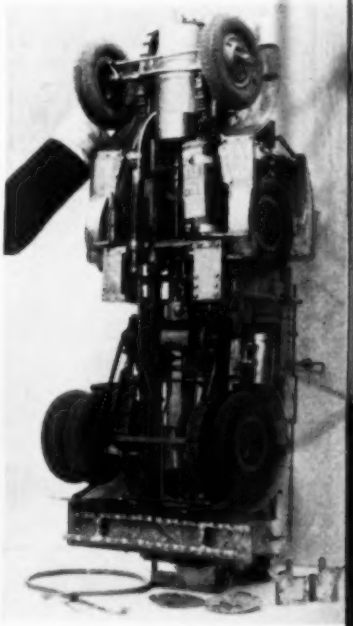
Lastly, but of prime importance to car life, keep the finish of your car's body, fenders, and hood protected by wax. This alone will save costly repair bills later on. When a fender or other part is damaged, have it repaired at once before rust can start. Then let the new finish harden about two weeks before applying the wax.

Auto Ideas

KEY AND LICENSE CONTAINER. In addition to a license pocket and a chain for holding car keys, this two-by-one-and-a-half-inch leather container has an attached plaque with a magnifying glass for reading road maps, a small compass, and a small tag into which an identification card may be inserted. It is available in pigskin, cowhide, and morocco, and the morocco is finished in either red, blue, or green.

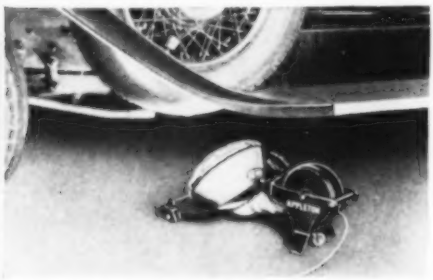
ANTI-STATIC POWDER. Static interference in your automobile radio now can be eliminated by putting a tablespoonful of a recently-developed powder in each tire on the car. To use it, the tire valve cores are removed, the tires deflated, and the powder blown in with an applicator. When the tires are reinflated, the dust remains in suspension in the air inside the tubes and neutralizes static caused by friction and insulation.

MODEL ASPHALT-SPREADER TRUCK. Complete in every detail, from air compressor and tiny locks on the spare wheels to detachable disks for the rear wheels to keep asphalt from getting on the chain sprockets, this model truck was built by Frank Moscoloni, of Everett, Mass. Using only hammer, pliers, and a chisel, he completed it in six months. The only items purchased in a finished form were the tires. The truck is 38½ inches long, 20 inches high, and 14 inches wide. It has three chests which contain models of all the necessary equipment for permanent and patch work on roads.



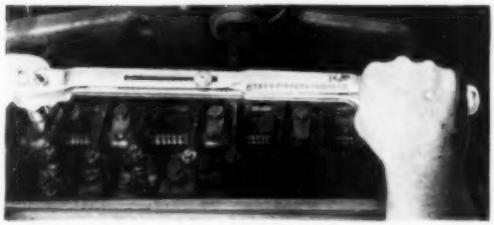
Auto Ideas

CAR WASHING IS MADE EASY with a new liquid preparation, one ounce of which to 10 gallons of clean water, hot or cold, does the job. A clean hand mitt is furnished with each pint can of the fluid. After going over the car thoroughly with the water-cleaner mixture, the car should be promptly hosed. No drying or chamoising is needed, and the car quickly dries itself to a glossy finish without streaks, according to the maker.



MOUNTED ON THREE WHEELS, one a revolving caster, a handy work light for garage mechanics can be rolled under a car like a creeper to the desired spot. A reel with 25 feet of cord is built into the unit, to rewind the cord automatically as well as to prevent it from becoming tangled. An adjustable reflector permits the light to be directed where needed so that it will not glare in the worker's eyes, while a handle near the center of the device makes it easy to carry with one hand.

BOTH EARS AND EYES tell you when you have applied the proper tension, determined in advance, to the handle of a new torque wrench. An easily read scale, calibrated in "pound feet" from 20 to 200, indicates visually when the desired tension has been applied. In addition, by setting buttons on the $19\frac{1}{2}$" wrench to the desired tension, the wrench is made to give off a sharp metallic sound when the torque reaches that tension while tightening a nut, bolt, or stud. A 36-tooth ratchet wheel with a twin double-tooth pawl permits an extremely short operating swing, and the wrench is reversed by a flip of a shifter. With each wrench, a chart is supplied giving the pound-foot tension to be applied on cylinder heads, connecting rods, main bearings, and so on, as recommended by the manufacturers of all popular cars and trucks.



A pointer beside the scale calibrated in pound feet tells the torque being applied by the wrench. By setting buttons, the wrench is made to click at any desired tension

HERE ARE YOUR NEW CARS for 1942. Spiking rumors, they appeared on schedule with striking appearance changes, a good measure of mechanical improvements, and every sign that the defense-busy makers found or made the time to plan better automobiles. Priorities materials are still part of all cars. Most appear essential to their manufacture. Under OPM edict, production must be cut 26½ percent under the output of last year's first four production months during those months this model-year. The whole uncertain production picture probably hinges on availability of the No. 1 priorities material — steel. Meanwhile, the new, 1942 cars are here.

CADILLAC

In this Series 61 for 1942, all essential changes of the Cadillac line are indicated. Note heavy grille

NEW CARS *for 1942*

BUICK From front to back fender on this body style in the 1942 line of Buicks, as well as in some of the convertible models, is exactly no distance at all, for the front fender extends clear back to the front of the back fender. When doors are opened the part of the fender covering them opens with them. Other bodies have front fenders extending part way along the front doors. Added protection is given by bumpers that curve and extend around the fender sides. New engine bearings and connecting rods are designed for longer life through greater strength. Twin dual carburetors with refinements are continued, and a pedal now operates the emergency brake

This front fender could not be longer unless it became a solid unit with the rear one. On some Buick sedans, the front of the rear fender is part of the rear door. Such fender panels open with the doors

Cadillac Pioneers in the extended front fenders with last year's 60-Special, Cadillac includes this design on all models except the 75-Fleetwood. Wheelbase of the new 62's is up three inches to 129, and of the 60-Special up seven inches to 133, for better leg room in rear compartments. Bodies are lower and wider, while the massive, round-nose hood now rises from a much heavier-looking, wide radiator grille. Heavier, sealed brakes improve stopping efficiency at high speeds. The 150-horsepower V-8 engine again powers all six of the series. A redesigned carburetor replaces the old one. Hydramatic transmission—an integral hydraulic clutch and automatic-gear-shift unit—is again optional equipment. Interior accessories, dashboard, and steering wheel are all restyled.

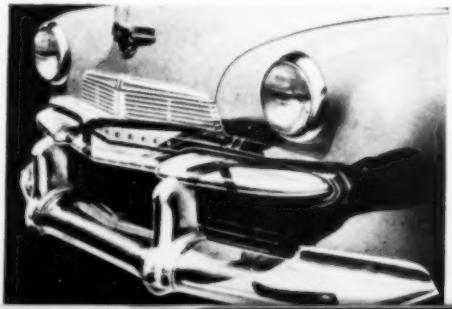
CHEVROLET Illustrated is the new Fleetline sedan. It has a completely redesigned front end, with wide, horizontal grille bars. Front fenders are carried to the center of the front door while a heavier belt molding runs from the radiator back through the rear quarter panel. Body dimensions are increased to make it longer, lower, and roomier. Continued is the six-cylinder, valve-in-head engine with unique Chevrolet oil system which combines pressure lubrication with directed-oil-stream oiling of connecting rods. Gear shifting is vacuum-booster operated.

Chrysler Six-cylinder engines are larger, increasing the horsepower from 112 to 120. Eights are up from 137 to 140 by means of larger intake valve ports, and improved manifolds common also to the six. Chassis front ends are sturdier, with stronger bumper mountings. Wide horizontal grille bars curve all the way around front fenders to the wheel cut-outs. Fluid Drive, with a semiautomatic transmission, is standard on the eights, optional on all sixes. The liquid-coupling unit has been redesigned to give greater engine efficiency in starting, in slow driving, and on hills. Bodies, essentially the same, have restyled accessories, and steering wheels are adjusted for greater comfort.

DeSoto Heading its new style features are its headlights, which are concealed for daytime driving. Moving a dashboard lever slides a panel sideways in the nose of each front fender, revealing the

STRIKING NEW FEATURES IN DESIGN, CONSTRUCTION, AND ENGINEERING

Beginning at the front bumper and running back along the car, the pictures below illustrate typical, important, and interesting new developments in the new cars for 1942. Chrysler's front end typifies the emphasis on horizontal lines and full-width radiator grilles. DeSoto's headlights are concealed behind panels that blend with the front fenders when closed and slide sideways when a dashboard lever is operated to turn the lights on. A "two-story" front bumper, strongly braced (see phantom view), distinguishes



lamps, which are also turned on by the operation of the same lever. Heavier and stronger bumpers curve far around fenders for added protection. While grille bars are vertical, the wide horizontal strip of trim extending from the center of the grille fully around the nose of the fenders to the rear ends gives the front end of the car a broad, streamline appearance. Bodies are made roomier and the doors completely cover the running boards. The strip of trim above the new rear-fender cut-out panels continues the horizontal effect from the front fenders. Length of the car is increased.

Ford Major news announcement from Ford is the possibility that the experimental plastic-bodied car shown above may go into production in a matter of months. Body, fenders, and hood are heat-and-pressure molded from farm-grown fibers and plastics. The 1942 Fords will have restyled radiator grilles and bumpers and roomier interiors. Running boards will be completely concealed by the doors. In addition, the recently announced Ford six-cylinder engine may be had in place of the V-eight type, at the buyer's option.

Dodge A brand-new motor, in which the compression ratio is stepped up from 6.5 to 6.8 to one, and piston stroke is increased by a quarter inch, gives the new Dodge 105 horsepower, instead of its former 96. The optional Fluid Drive unit is 13 inches in diameter, with improvements for better start and pick-up. The wheelbase and body dimensions are the same as last year, but the steering wheel, hardware, and trim are restyled. Wider bumpers and heavier radiator grille add to the rugged appearance of the front end, while the parking lights are now set beneath the headlights instead of above them.

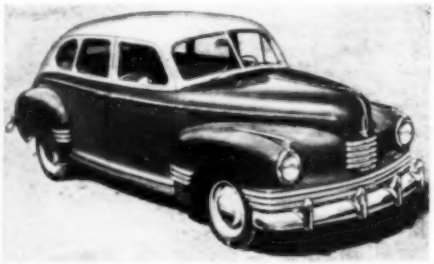
HUDSON Lower, longer, streamline bodies with concealed running boards to prevent snow and ice from collecting on them are announced among the Hudson features. Spotlighting the Hudson of-

GRACE THE NEW 1942 CARS—HERE ARE SOME OF THEIR DETAILS

the front end of the Oldsmobile. Dodge (below) along with Chrysler and DeSoto, offers white-enameled extra wheel rims—in lieu of white-sidewall tires which Government priorities have put out of production. Many new cars have front fenders extending backward across the doors. How the part attached to the side of the door telescopes into the main body of these fenders is illustrated clearly in the Pontiac detail shot, while the last picture shows an interesting self-cleaning ash tray Pontiac offers

ferings is an optional transmission called the Drive-Master. It combines a vacuum-operated clutch with a semiautomatic transmission. Three buttons on the dash let the driver select whether he is to drive the car with conventional clutch and gear lever, with the vacuum clutch operating, or with both the vacuum clutch and the semiautomatic transmission functioning. Two sixes, of 92 and 102 horsepower, and an eight of 128 power the three lines of Hudson cars.

Lincoln-Zephyr MERCURY Breaking from the familiar radiator pattern, Lincoln's three lines—Zephyr (above), Continental, and Custom—display an entirely new front-end appearance. Big news on Lincoln, however, as well as Mercury, is the offering of a hydraulic clutch in combination with a semiautomatic transmission. The Lincoln Custom and Continental have buttons instead of handles on the door interiors and exteriors, as well as on the knob of the rear trunk lid. Both the Lincoln and Mercury lines have new fenders, and the hood on the Continental is again considerably longer than on the other Lincolns. A radial-spoked flywheel described as "flexible" is designed to cut vibration throughout all speeds on the Lincoln engine, which continues to be the only 12-cylinder engine in an American car.

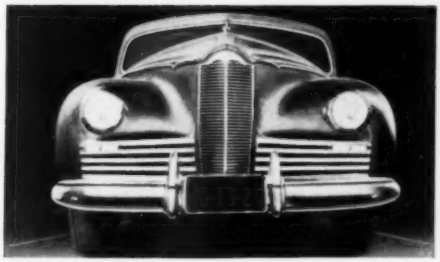


NASH The full-sized but economical Ambassador '600', introduced last year, offers a restyled radiator assembly and a body construction said to be similar to the "monocoque" principle used in building certain types of airplanes. The car also has coil springs on all wheels, and its front-wheel steering gear is of unusual design. On the Nash Ambassador six and eight, twin ignition has given way to single spark plugs for each cylinder. While overhead valves are continued on these models, the engine heads are changed and an entirely new combustion chamber is said to increase power, cut fuel consumption, and

SIMPLIFIED CONTROLS ADD NEW COMFORT AND CONVENIENCE

At left, arrows point to floor pedal for foot operation of the Buick emergency brake, and to the dashboard trigger for releasing it. Next picture shows Hudson's three-button dash control for selecting the desired transmission operation: conventional, with vacuum clutch, or with vacuum clutch plus semiautomatic trans-

eliminate pinging and knock even with non-premium gasolines. Radiator grille work that extends around the edges of the fenders is common to all new Nash lines.

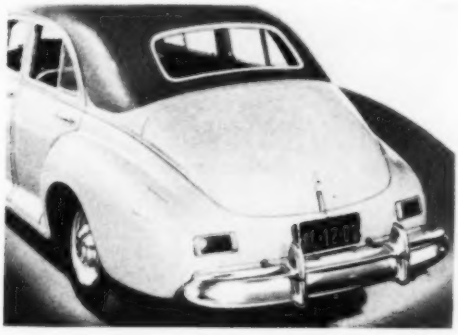


OLDSMOBILE A heavier frame carries both the sixes and eights, and while the overall weight of the cars is increased, gasoline economy is said to be improved through the use of a higher-compression cylinder head. Long front fenders sweep back beyond the middle of the front doors on all models. Besides heavier radiator ornamentation, the outstanding front-end innovation is a "two-story" front bumper. This is actually an extra bumper, mounted on the tops of the bumper guards, but further reënforced against impacts by concealed steel mountings that extend well back and anchor on the chassis side rails. The fully automatic Hydramatic transmission with its hydraulic coupling is available on all models. It has undergone several minor improvements. Both front and rear seats are wider in every body style, with increased headroom for added comfort. Body styles in sixes and eights are identical.

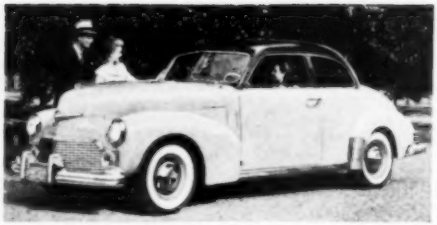
PACKARD Styling of the Clipper, surprise Packard introduction last spring, has been adopted for many of the 1942 body types. These will include both six and eight-cylinder cars, with more traditional Packard lines retained on a few bodies. Distinguishing the Clipper styling are front fenders which extend back into the middle of the doors. The curves at these points are so gradual as to blend without crease or molding into the door panels. A novel structural detail of the Clippers is to be found in the rear fenders as well. These are stamped in one piece and in the same operation with the rear quarter panel. Still available is the automatic clutch, which makes use of the clutch unnecessary for changing gears. Engine horsepower on the 120 series is stepped up to 125, and corresponding increases will be made in other models. As formerly, the Clipper design will continue to provide one of the lowest-to-the-ground cars on the market, while a double-drop-type chassis permits low roof without sacrifice in head room.

TO MANY OF THIS YEAR'S CROP OF PASSENGER-CAR DESIGNS

mission. As a safety measure, Studebaker offers the finger control under the steering wheel for tuning your car radio. Just under the lever is another for fore-and-aft turn-indicator lights. Directly below, note how the rear-fender sheet metal makes a smooth reverse curve to become part of Packard's rear quarter panel. The one-piece stamping not only saves time in manufacturing but, like so many engineering developments, results in a better-looking, more practical, and cheaper-to-build product. Last photograph illustrates the push button that releases the latch on the rear trunk lid of the Lincoln line of cars. After the button has been pressed, the lid, counterbalanced with springs, lifts easily



Plymouth A lower, heavier chassis carries the new Plymouth body closer to the ground for added stability on curves. By means of carburetor, valve, and manifold changes, engine horsepower is increased 10 percent, to 95. Heavy, broad fenders, long horizontal grille bars, and deep bumpers add to the effect of the car's lowness. Underneath the bumper is an air scoop which forces more air into the radiator. The car's floor is level with the running boards instead of above them, and the doors completely conceal them when shut. The increased horsepower is said to have been gained without increasing engine speed, making possible a lower rear-axle gear ratio of 3.9 to one. Less engine wear and lower upkeep costs are listed as the consequent gains. More room is provided between the front seat and steering wheel. Both front doors have key-operated locks. Horns, wired through the ignition lock, will not blow unless the ignition is turned on.

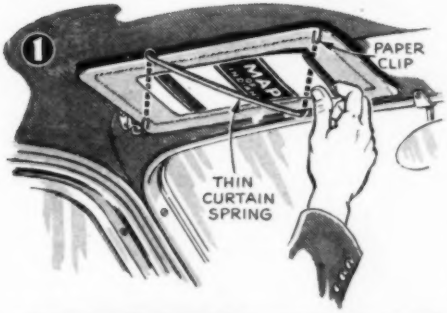


STUDEBAKER Another to add a hydraulic coupling to its 1942 cars, Studebaker offers it as optional equipment on its six-cylinder Commander and its eight-cylinder President lines. The Champion, a smaller six, is available with overdrive. The fluid coupling is combined with a semiautomatic transmission of the overdrive type, but has an automatic clutch which permits elimination of the clutch pedal. Pictured above is the President sedan-coupe, available on the Commander as well. With a new, wider radiator grille and wider, lower hood, Studebaker offers greatly restyled lines. A special series on the Commander and President chassis, called the Skyway model, has special streamlined styling. Planar, independent-front-wheel springing is continued. This is somewhat similar to knee-action springing, except that a transverse leaf spring is used in place of two coil springs. All models are available with a hill-holder unit.

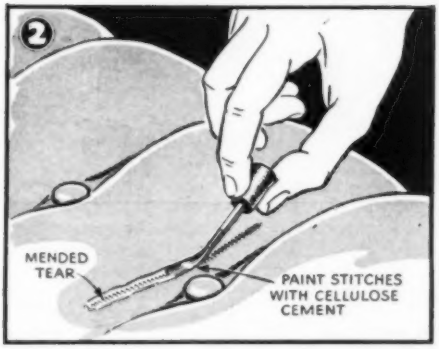
PONTIAC In two lines—DeLuxe and Streamliner — all Pontiac models are again available with either six or eight-cylinder engines. Steering gear, transmission, and rear axle do not have to be lubricated for the life of the car. Wider front brake drums and shoes add to stopping efficiency through better distribution of braking effort, while front and rear brakes are triple-sealed against moisture and dirt. A new copper-finished instrument panel and leather kick pads around the base of both front and rear seat are principal interior changes. Fenders carried back into the doors, greater use of horizontal lines, a wider radiator grille and bumpers, add to the appearance of car width, and bodies are three inches longer. Wax-soaked wood strips separate the rear spring leaves.

WILLYS Improved soundproofing of bodies, floors, and engine panels adds to the big-car "feel" of the new Willys Americars, which are one third lighter than the average of the four best-selling cars. New decorative molding changes the appearance of the radiator grille and hood, and all models are available with or without running boards in both the DeLuxe and the Speedway series. Efficiency of the four-cylinder, 60-horsepower engine is improved by a newly designed heat-control mechanism in the manifold, which has a temperature adjustment.

FOR CAR OWNERS



1 A HANDY MAP HOLDER, as well as a holder for memos, salesmen's call lists, and other paper items, is provided by a spiral spring of the type sold for curtain rods fastened to the sunshade above the steering wheel, as shown. Hooks formed in each end of the spring permit it to be attached or removed quickly.—A.L.G.

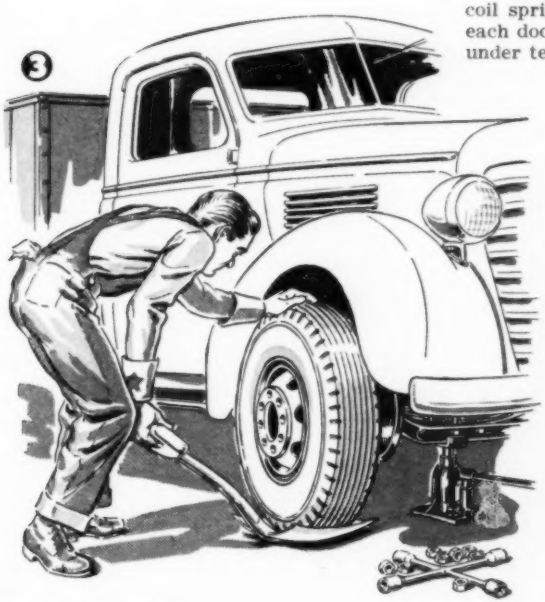


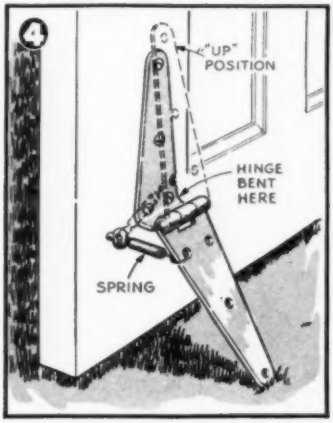
2 STRONGER DARNS AND MENDS are made on torn upholstery if the stitches are given a coat of model-airplane wing dope. If the mending thread should break some time later, the dope will keep the repair from unraveling. Clear finger-nail polish or cellulose cement serves the same purpose.—S.R.

3 EASIER REMOVAL OF WHEELS from heavy trucks is possible with the simple expedient shown below. Simply push a short-handled shovel or spade under the jacked-up wheel, remove lugs, and work the wheel free. It will drop into the shovel blade which acts as a skid on which to drag the wheel as the other hand steadies it.—W.F.B.

4 GARAGE-DOOR STOPS that automatically snap up or down at a touch of the toe to allow doors to be closed or to hold them open against a wind, can be made cheaply from a pair of strap hinges and two short coil springs. Bend and mount one hinge on each door, as shown, and attach the springs under tension with screw eyes.—J.L.S.

Drawings by
STEWART ROUSE





GUS talks tire turkey!

Rubber is a strategic material now. But it takes very little strategy to improve tire mileage

By MARTIN BUNN

JOE CLARK was busy and testy over the job of sending the Model Garage's customers their monthly accounts, and Bill, the mechanic, was out with the wrecker, so Gus Wilson was taking care of the gas pump—a job he detests.

He'd just sent a customer on his way with a full tank and was heading relievedly for the shop door when he was stopped by the excited honking of a horn. Turning, he saw the Miller sedan coming up the driveway in a hurry. It stopped with an outraged shriek from its misused brakes and a squeal of rubber that made Gus wince.

Mrs. Miller, smiling brightly, stuck her marcelled head out of the window and, as is her way, immediately began to gush conversation. "Oh, Mr. Wilson, I'm in *such* a rush! Conference after conference! I've been at a meeting of the Defense League all afternoon, arguing and *pleading* that rifles be provided for us women, and that we have military drill. Don't you think that's a good idea, Mr. Wilson?"

"Well," Gus started, "it seems to me that . . ."

"Of course you do!" Mrs. Miller broke in. "It would seem that way to anyone who didn't have submersive—I mean subversive—ideas. But I was *overruled*, Mr. Wilson! Those who are content with half measures contended. . . . Now, what *was* it that I stopped for? Oh, yes—gasoline. My tank's empty."

Characteristically, Mrs. Miller had stopped her car in a position which put the filler of the gas tank a foot beyond the range of the pump hose. "If you'll just move forward a little—" Gus suggested.

"Oh, of course—how *stupid* of me!" Mrs. Miller released her brake, stepped hard on the accelerator, and jammed the brakes on again in a sudden maneuver which made her car leap forward six feet and stop like a startled jack rabbit. Then she stuck her head out of the window again and continued her conversation as Gus filled the tank. "I try *so* hard to save gas, but somehow I'm always running short on it. But what else was it that I—oh, yes, of course. Tires. I heard an OPM man speak at a meeting yesterday, and he told us that before long rubber products are going to be almost impossible to get. So I told Henry that we'd better buy a new set of tires right away. He said to ask you what you thought about it."

Gus made a circuit of the car as he examined the tires. One rear appeared to have at least five pounds more air in it than the other, and both of them had numerous flat spots on their treads, the result of Mrs. Miller's too-emphatic braking. Three of the four valve caps were missing. The outside wall of the right front was badly cracked from the hard knocks it had taken against curbs, and the treads of both fronts were worn in an uneven, scalloped pattern. The spare, which apparently never had been

Mrs. Miller stepped hard on the accelerator and jammed on the brakes, making her car leap like a startled jack rabbit

Gus inflated all four of the car's tires to their proper pressure. Then he had Miller run the car onto the test rack

used since it was bought, felt dry and brittle.

"You need a new set of tires, all right," Gus said. "But just new tires wouldn't do much good. Your front end is badly out of alignment, Mrs. Miller."

"You mean that my car should be put on that funny testing machine again? Why, you did that, and sent Henry a big bill, only last spring."

"Yes," Gus said, "but wheel alignment is something like gasoline and tires—you use it up as you drive, and it has to be replaced. Unless your front end is straightened out your new tires soon will be as badly worn as the ones you have on now."

"Well," Mrs. Miller decided, "I'll have to speak to Henry about it."

She kicked the starter, released her brake, and stepped on the gas so suddenly that the rear wheels spun, and the car shot down the driveway.

George Knowles had driven up to the pump. He looked at Gus and shook his head. "That woman," he said, "is a public menace. The gas and oil and rubber she wastes would keep a tank running. There ought to be a law!"

Gus nodded. "The funny thing about it is that no one has better intentions than our friend Henry's wife," he said.

Knowles snorted. "You know where they've put a priority on good intentions—for paving material!" he said. "There ought to be a law!"

Several of us dropped in at the Model Garage that evening. We sat around talking about the shortage in rubber and how darned careful we'd all have to be of our tires as we watched Gus fussing with a wheel he'd taken off his own roadster. Finally some one asked him what he was doing.

"I'm doing what you fellows are talking about," he said, looking up with a grin. "Making my tires last longer."

"How?" Doc Foley asked.

"By balancing this wheel," Gus told him. "As you see, it has a new tire. The tire happens to have a heavy spot in it and these two half-ounce weights I'm attaching to the rim opposite the heavy spot when properly spaced will balance the wheel exactly. Balancing the wheel will keep it from shimmying, the tire will run cooler and wear evenly, and I'll get longer service out of it. And because the balanced wheel won't pound the road the way an unbalanced one would, there'll be less vibration and my car will last longer."

Ez Zacharias shifted his cud of tobacco into his left cheek. "Shucks!" he said disparagingly. "That heavy spot that's got

you all het up—how much does it weigh?"

"About an ounce," Gus told him. "That doesn't seem much, but one ounce out-of-balance at the rim generates a centrifugal force of 12 pounds at 60 miles an hour and of 21 pounds at 80 miles an hour—not that I'm fool enough ever to drive at 80. But even at 35 the radial force jerks the wheel up and down and sideways, and shimmy begins. That makes driving uncomfortable, and makes the tire wear unevenly and also wears the kingpin bushings and tie-rod ends unnecessarily. The radial force . . ."

Ez growled. "Quit talkin' like a college perfesser! I don't have to know nothin' about radial forces to drive my R. F. D. route, and I ain't goin' to start addlin' my brains over a lot of such-like highbrow stuff. I jest want to know, in plain English, how I can make my tires last longer."

"That's what we all want to know," Doc Foley put in. "How about it, Gus?"

"Well, there are three ways of doing it," Gus said, "and no one of them is of much use without the other two. By driving sensibly, by giving your tires a little attention *before* they start giving you trouble, and by keeping your bus in first-class mechanical condition."

"Just what do you mean by driving 'sensibly'?" Doc asked.

"I mean using your head to save your rubber," Gus said. "A sensible driver doesn't wreck the sidewalls of his tires by carelessly scuffing them against the curb when he parks. He isn't so set on beating the other fellow on every get-away that he tramps on his gas so hard that his rear wheels spin. He doesn't make cowboy stops at the expense of wearing flat spots on his tire treads by making his wheels slide. He doesn't take sharp curves at high speed, he doesn't overload his car, and he doesn't drive at sustained high speed unless he's really in a heck of a hurry to get some place—which most of the speed demons you see on the roads aren't!"

"Well," George Knowles remarked, "I don't think that any of us here tonight are guilty of those elementary forms of foolishness—not often, anyway. But this attention you say we should give our tires—just what sort of attention do you mean?"

"Now I'll ask you one," Gus came back at him. "How often do you have the pressure in your tires checked?"

"How often? Why, whenever I think they need checking," Knowles said.

"That isn't often enough—or regularly enough," Gus told him. "You should have your tires checked once a week—whether or not you think they need it. Improper inflation is the most common cause of unnecessary tire wear. And by improper inflation I mean greater pressure or less pressure than is recommended by the makers of your car and tires. Underinflation causes unnecessary wear on the sides of the treads, and overinflation causes excessive wear on the center of the treads. And you should make certain that your inflation is balanced—that there isn't a difference in the pressure in the two tires on the same axle. Unbalanced inflation causes hard steering, undue tire wear, and waste of gasoline.

"When you've got the correct pressure in your tires, help to keep it there by keeping the valve caps properly tightened down. They act as a seal for the air in the inner tubes, as well as keep the dirt out."

"I've been checkin' up," Ez Zacharias said. "I reckon I rate 100 percent on takin' care of tires, Gus."

"You do, hey?" Gus said. "How about your spare tire?"

"I ain't never had to use th' one I've got on now, an' I've traveled over 30,000 on my rubber!" Ez cackled.

"Last time you had your car in here I noticed that your spare never had been used," Gus said. "You're making a mistake, Ez. Your spare is deteriorating as fast lying there in its compartment as it would be wearing out if you were giving it its fair share of use. What you're really doing, in the long run, is paying for five tires to get the mileage out of four."

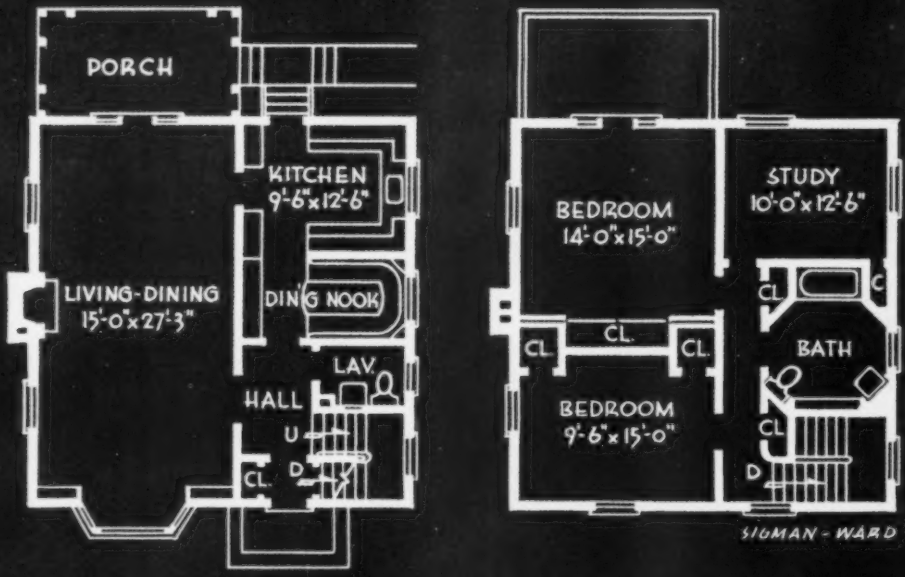
Ez thought that over—and saw the light. "By cracky, I believe you're right!" he yelled. "First thing in th' mornin' I'll yank off a tire and put that spare to work!"

"If you want to get the greatest possible mileage out of the five tires in a set," Gus told him, "just substituting your spare for another tire isn't enough. You should *shift* all your tires about every 4,000 miles. Take off the right front—that's the tire that gets the most scuffing—and put it in the spare compartment. Shift the left rear to the right front. Replace the left rear with the left front. Shift the right rear to the left front. *(Continued on page 218)*

GUS SAYS:

You'd laugh at me if I told you how many cars come in here with worn-out spark plugs. Yet there aren't many parts replacements so important to car economy. New plugs soon pay for themselves!

HOME AND WORKSHOP



FIRST-FLOOR PLAN

SECOND-FLOOR PLAN

House-Planning Contest: The Second-Prize Design

Second-Prize HOUSE

COMBINES STYLE, ECONOMY, CONVENIENCE

The second award in our $1,000 house-planning contest, as announced last month, was won by Charles Richard Hogan, of Chicago, Ill. The complete set of plans he submitted is reproduced on the facing page, and the specifications are given on pages 149-151. An illustrated personality story about him appears on pages 152 and 153.

The following analysis of his entry was prepared by Greville Rickard, A.I.A., architectural consultant of POPULAR SCIENCE:

THERE is considerable charm to Mr. Hogan's second-prize design—the charm of simplicity and dignity, and of easy comfort both in layout and in exterior elevation. It does not reach out anxiously to cry for attention with forced originality, yet it is not without freshness of idea. Its wide corner boards and cornice help give it gracious individuality. One will no more tire of this pattern than he will of the English language.

The plan fits a narrow lot and therefore is one that should meet the requirements of a large number of small families.

The east wall will be less attractive than the others due to lack of good window alignment. If all windows, for the sake of consistency, are to have shutters, the windows on the stairway should be moved to avoid having a shutter hanging over the corner board. The stone base on the bay will look heavier still on its diagonal projection. One wonders whether shingles might look as well.

Let us now enter and look over our commodious cellar. The owner's hobby of making furniture will be comfortably sustained with plenty of space and good light, as will also the operation of washing clothes.

Going to the first floor, we find the orientation favorably worked out. There will be sunshine for breakfast and again for dinner. The kitchen is ample and has good storage space and circulation. The very attractive nook is perhaps space-wasting, and half of it could give way to two closets. The living room lends itself to being divided into two activity spaces. The bay is a pleasant feature, as is also the porch at the opposite

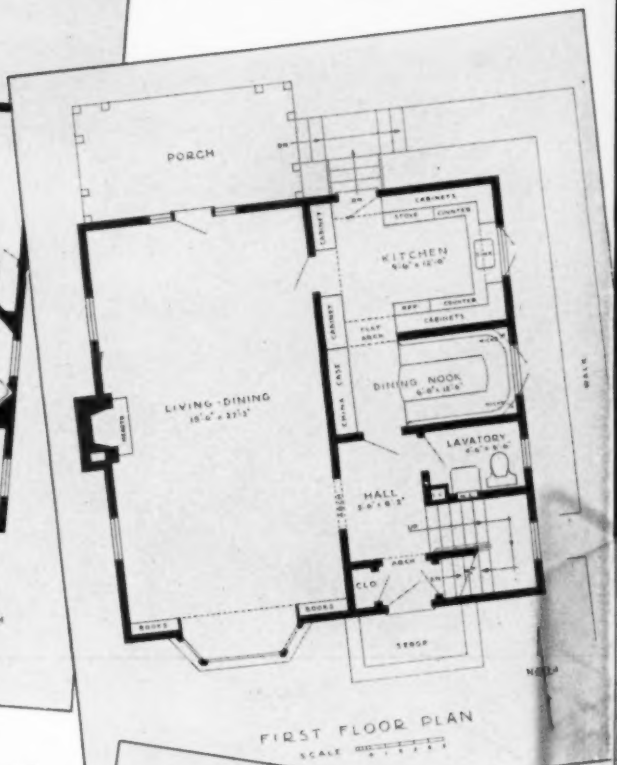
(Continued on page 149)

ADVANTAGES OF HOUSE PLAN AS LISTED BY CONTESTANT

1. Orientation of rooms.
2. Cross ventilation in all main rooms.
3. Stock windows and doors have been used for economy.
4. Stock lumber lengths have been used with a minimum of waste.
5. The vertical alignment of plumbing fixtures keeps cost down.
6. Good circulation between rooms.
7. Ease of communication and circulation; also storage space in kitchen for good service.
8. Doors and windows are spaced for room interest and furniture arrangement.
9. The study is isolated from the rest of the house.
10. Economy of space in stair arrangement.
11. The use of stained shingles on a frame house keeps painting costs relatively low throughout the years.
12. This plan contains unusual features such as large dining nook, octagonal-shaped bathroom, and sliding doors in north bedroom closet.

SECOND FLOOR PLAN

SCALE



FIRST FLOOR PLAN

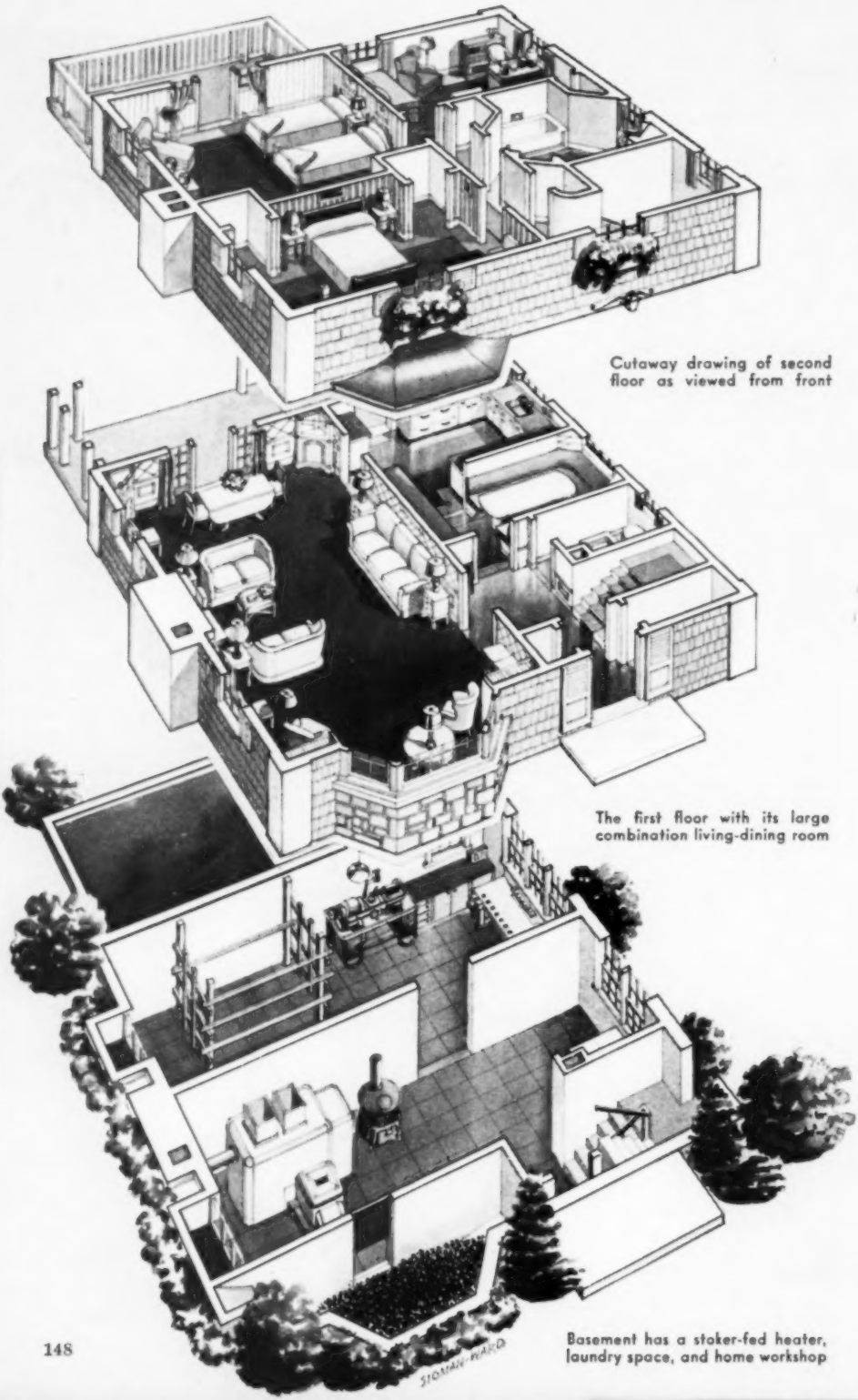
SCALE

Although greatly reduced in size, these are exact reproductions of Mr. Hogan's drawings. The house, 29' square, is suitable for a comparatively narrow city lot. It contains 23,000 cubic feet. The cost of construction is estimated by Mr. Hogan at $6,200. Exterior, wood shingles; roof, asphalt shingles

FRONT ELEVATION

BASEMENT PLAN

SCALE



Cutaway drawing of second floor as viewed from front

The first floor with its large combination living-dining room

Basement has a stoker-fed heater, laundry space, and home workshop

end, while the walls have good space for furniture. The stairway is a bit crowded as to the first step up and the first step down.

The upstairs is excellent. Important rooms have cross ventilation, good furniture space, and easy circulation, while closets are well arranged. The octagonal bathroom is luxurious, but a feature that can add to the joy of living.

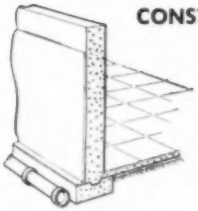
The specifications are surprisingly complete. They should not, however, be confused with the needed documentary type of specifications prepared by an architect, having protective legal status with a contract.

SPECIFICATIONS

IN SUBMITTING his plans, Mr. Hogan included a detailed outline of specifications covering the construction, decoration, and furnishings. This outline follows, exactly as he prepared it:

House size—29′x29′
Cubage—23,000 cu. ft.
Cost of house—$6,200
Plot size—60′x125′
Cost of plot—$1,200
Size of family—Two adults, one child
Income group—$2,000 to $2,500 per year

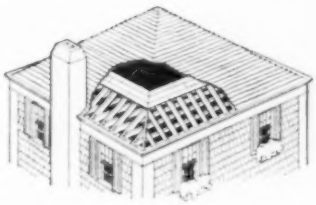
CONSTRUCTION



FOUNDATION. Poured concrete foundation 8″ thick. Membrane waterproofing. 4″ drain tile around concrete wall. Vitrified tile sewers.

WALLS. Wood sill, 2″x6″, bedded in mortar and anchored. Balloon framing, 2″x4″ studs, 16″ O. C. (on centers), No. 1 Y. P. (yellow pine). 2″x4″ fire stopping. Diagonal exterior wall sheathing, 1″x6″ D. & M. (dressed and matched), No. 1 Y. P. Lannon stone (limestone) bay, cement mortar. Insulation, Johns-Manville 4″ rock-wool batts. Samuel Cabot creosote-stained wood shingles. Roofing paper under shingles. Gold Bond perforated gypsum lath (walls and ceiling). Gold Bond plaster (walls and ceiling). Keene's cement for bathroom (walls and ceiling). Wire lath in all corners.

FLOORS. Basement floor, 4″ colored concrete on cinder fill. First and second floor joists, 2″x10″, No. 1 Douglas fir. Attic floor joists, 2″x8″, No. 1 Douglas fir. Johns-Manville rock-wool batts between attic floor joists. 2″x3″ joist cross bridging. Subflooring, first and second floor, 1″x6″, D. & M., No. 1 Y. P. Flooring, first floor, ⅜″ Douglas fir plywood. Flooring, second floor, oak (bathroom ⅜″ plywood). Steel beam supports for first-floor joists. Steel Lally columns. Cement plaster ceiling over coal bin.

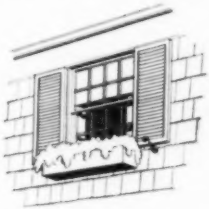


ROOF. Rafters, 2″x6″, No. 1 Douglas fir. Roof sheathing, 1″x6″, D. & M., No. 1 Y. P. Johns-Manville asphalt roof shingles. Roof felt under shingles. Bay window roof, 16-ounce copper. Galvanized-iron flashing. Gutters and leaders, 26-gauge galvanized iron.

CHIMNEY. Common brick, cement mortar. Fire-brick fireplace lining. Terra-cotta flue lining. Cast concrete cap, black. Donley fireplace damper and ash-pit hardware. Wood (birch) mantel; marble trim and hearth.

DOORS. Interior doors, birch Rezo flush doors. Door locks, butts, and handles, Payson. Exterior doors, white pine. Storm doors, white pine. Screen door, bronze mesh, for kitchen and porch. Master door weatherstripping.

WINDOWS. Andersen wood casement and hardware. Andersen Narroline double-hung. Master Metal weatherstripping. Single-



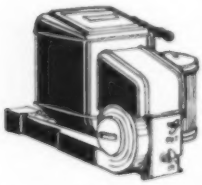
strength glazing. White-pine wood storm sash. Window screens, bronze mesh. Roller shades. *(Continued on page 150)*

STAIRS. Hall stairs: Oak treads, stained and varnished; birch risers, enameled ivory; balusters, birch, turned and enameled ivory; handrail, birch, stained and varnished. Basement stairs, yellow pine, closed risers. Outside stairs, concrete.

EXTERIOR WOOD TRIM. White-pine wood shutters. Wood fascia, 1" x 14" No. 1 W. P. Corner boards, ⅜" Super-Harbord plywood. Casing, white pine.

INTERIOR WOOD TRIM. Two-member wood base, in birch. Birch interior window and door casings. Birch cornice in living room and hall. Wood clothes chute, kitchen cabinets, built-in nook furniture, and living-room bookcases.

PLUMBING. "Standard" bathroom and lavatory fixtures. "Crane" laundry tubs. Stainless steel kitchen sink. Galvanized water pipes. Shower head to be located over tub. Cock for garden-hose connection.



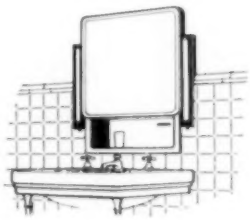
HEATING. Fitzgibbons Directaire conditioner. Minneapolis-Honeywell heating controls. Schwitzer-Cummins bin-feed Stokol Stoker. Burnham hot-water supply boiler, coal fired. Burnham galvanized hot-water tank. Galvanized iron ducts. Uni-Flo register grilles. Majestic grade-line coal chute. Bituminous coal as fuel.

ELECTRICAL. Westinghouse electric wiring. Underwriters' specifications. Minneapolis-Honeywell heating controls. Lighting fixtures to be standard and of designs appropriate for the various rooms. Power outlet for stove. Rear-door buzzer. Front-door chimes. Closet-hinge switches.

ELECTRICAL APPLIANCES. Frigidaire refrigerator. General Electric stove. Bendix washing machine. Hoover vacuum cleaner. Singer sewing machine. Ironrite ironer. Thermador electric bathroom heater. Signal electric kitchen ventilating fan. R. C. A. radio-phonograph. Delta power tools. (Note in the basement plan that a specially large workshop has been provided.)

EXTERIOR PAINTING. Eagle-Picher white lead and oil. All trim to be painted white. Common brick chimney painted white. Shingles to be predipped green.

INTERIOR PAINTING. Pratt & Lambert spar varnish for floors. Sherwin-Williams paint for walls and ceilings. Benjamin Moore enamel for woodwork. For the color schemes of the various rooms, refer to the section on interior decoration below.



MISCELLANEOUS. Hall-Mack medicine cabinet and bathroom accessories. Wood flower boxes, white pine. Foot scraper. Built-in letter box. Front-door knocker. Removable screen for porch, bronze mesh. 4" concrete walks and porch floor. Ground terraced on south and west.

INTERIOR DECORATION

LIVING-DINING ROOM. Floor, green figured Wilton carpeting. Walls, cream wainscot to sill height; cream and green figured Imperial wall paper. Woodwork, cream enameled. Ceiling, cream flat paint. Furniture, 18th Century English (mahogany and satinwood). Figured cotton and rayon draw draperies. Color scheme to be based upon using green as the main color, with reds, yellow, and gold as secondary colors.

RECEPTION HALL. Floor, Armstrong linoleum, green and cream figures. Walls, green Marlite marbleized wainscot. Imperial wall paper, green ivy on cream ground. Ceiling, cream flat paint. Woodwork, cream enameled over a suitable undercoat. Stair carpet, flowered Wilton.

KITCHEN AND NOOK. Cabinets and woodwork, enameled white. Counter top and back splash, Armstrong maroon linoleum. Walls and ceiling, semigloss chartreuse paint. Floor, Armstrong linoleum, marbleized maroon field, solid gray border; 1" wide yellow inlay strip between field and border. Black rubber cove base.

LAVATORY. Floor, black marbleized linoleum (Armstrong). Walls, gray and yellow Sanitas covering. Ceiling walls and woodwork, cream enameled. Fixtures, yellow.

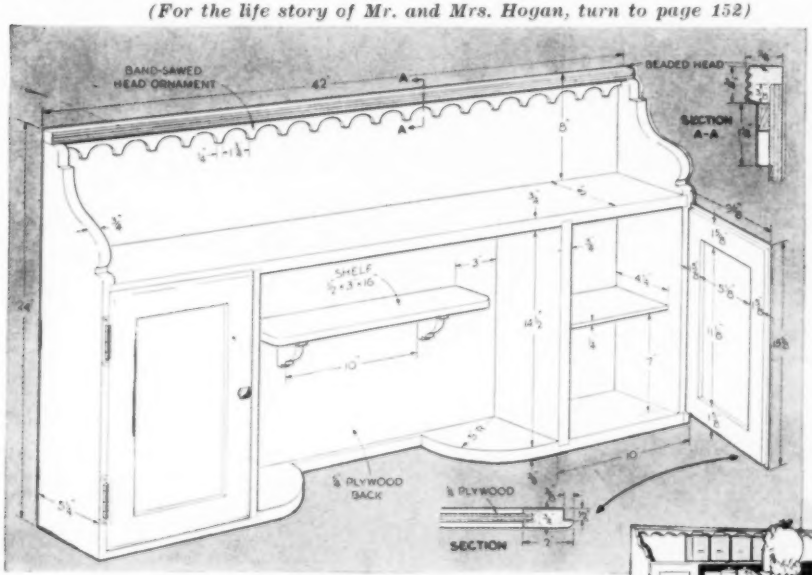
SOUTH BEDROOM. Floor, oak, stained and varnished. Rug, blue figured Wilton. Walls, blue and gray striped Imperial wall paper. Woodwork, white enameled. Ceiling, white flat paint. Furniture, Sheraton mahogany. Color scheme: main color blue, with orange, brown, yellow, and gold.

NORTH BEDROOM. Floor, oak, stained and varnished. Rug, rose quartz Wilton. Walls, pink pin-stripe Imperial wall paper. Woodwork, green tint, enameled. Ceiling, green tint, flat paint. Furniture, Louis XVI, French. Color scheme: main colors, pink and chartreuse.

STUDY. Floor, oak, stained and varnished. Rug, dark green Wilton. Walls, mahogany Flexwood. Woodwork, birch, stained mahogany and varnished. Ceiling, buff flat paint. Furniture, the so-called "English lounge" style. Color scheme: forest green and cherry red.

BATHROOM. Floor, Armstrong linoleum, rose-tone field, gray border. Walls, turquoise linoleum wall covering. Ceiling, warm, soft gray. Fixtures, "Standard" in rose tone.

(For the life story of Mr. and Mrs. Hogan, turn to page 152)



Kitchen Spice Cabinet Hangs on the Wall

The cabinet provides storage space for tea, coffee, sugar, salt, salad oil, and spices

BUILT to the specifications of a housewife who could not find in the stores exactly the type of kitchen spice cabinet she wanted, this design proved so satisfactory that three orders were immediately received for others like it. Common 1" pine of the No. 1 grade, dressed to 13/16", is used for all parts except the door panels, shelves, and back, which are fir plywood. Make the sides first, then the vertical pieces, followed by the shelves. It is best to reënforce the rabbet joints with screws set in about 1/16" and plugged. The doors are constructed with open mortise-and-tenon joints. Leave about 1/16" play in each direction for the door panels in their grooves and do not fasten them. The top beading was applied with a hand beader, but it can be left off without noticeably altering the appearance.—HAROLD G. PETERSON.

Hogan's skill as a designer and craftsman may be judged by these three pieces of furniture, which he built in his home workshop. The flower painting also is his work

Second-Prize Winner

BUILDS FURNITURE AS A HOBBY

CHARLES RICHARD HOGAN, winner of the second prize in the POPULAR SCIENCE home-planning contest, is a 27-year-old draftsman of Chicago, Ill. His spare-time hobby is designing furniture. Every room in his prize-winning home was worked out to utilize original pieces of furniture he has designed. Some of these he has already built in his basement workshop—a dining-room table, six dining chairs, bookcases, a sofa, a hall chair, and several living-room chairs.

Before the contest started, Hogan had filed away more than fifty sketches of architectural details of a house he hoped to build some day. Working on his plans evenings from 6 p.m. until midnight, he spent more than 100 hours on his submitted design. The hardest part of completing the plans proved to be the stairways. Every detail, down to the last screw and hinge, was worked out with the aid of catalogues from leading hardware and building-material concerns. His wife aided by typing the final specifications and working with him on the details of the various rooms.

Ever since he was a small boy, Hogan has been interested in buildings. His father was a contractor, and each summer the boy designed and constructed a variety of back-yard play sheds from odds and ends. He built and tore down as many as twelve sheds in a single summer.

Before he learned to write, Hogan was able to draw excellent pictures, and today he does outstanding work in water colors and oils. In high school, he took all the mechanical-drawing courses he could get. Graduating in the midst of the depression,

he worked for a time as a carpenter, then got a job on an automobile assembly line, and finally obtained his present position as draftsman with a Chicago concern which builds and leases factories.

Two years ago, a friend asked him to help design a home he wanted to build in a suburb of Chicago. Hogan worked out the details for a $9,000 Cape Cod type house which already has been erected in Oaklawn. His ambition is to become an interior decorator and furniture designer. Ever since he was in high school—and used to carry a tapeline in his pocket to department stores to measure the dimensions of chairs and sofas that caught his eye—Hogan has been making furniture of his own. He has a variety of machine tools in his home workshop—circular saw, lathe, scroll saw, jointer, shaper, and drill press.

At present Hogan has his eye on a small home in Chicago, which he plans to remodel. It is for this purpose that he intends to use his prize money.

Winner

HOUSE CONTEST

Mrs. Hogan helped in planning the color schemes of the various rooms and also typed the detailed specifications. The young couple have no children

Hogan takes time off from his workbench to help with the dinner dishes. He has had a variety of mechanical jobs, but is now engaged in drafting

An artist in wood, Hogan lavishes such skill on his furniture that he produces "museum" pieces. His ambition is to become a furniture designer

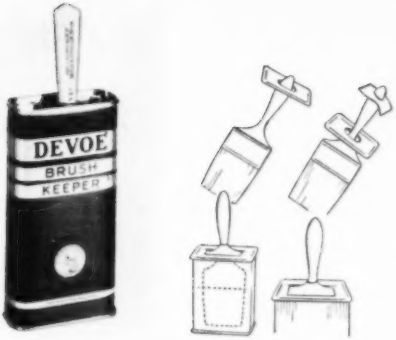
Architecture fascinates Hogan, and he has designed many houses just for fun. This is one that was actually built by a friend in Oaklawn, Ill.

IDEAS for HOME OWNERS

ITS MOLDED PLASTIC LENS reflecting light, this permanent driveway marker is visible for a quarter mile. The numbered panel, which can be read at a distance, is available in duplicate if the marker is to be seen from two sides. The metal standard is equipped with two spreading anchors, which lie flat when the post is being driven into the ground, but work their way outward at an upward pull. The panel is warpproof and the lens holder plated against weather. They are bolted to the standard after it has been put in place.

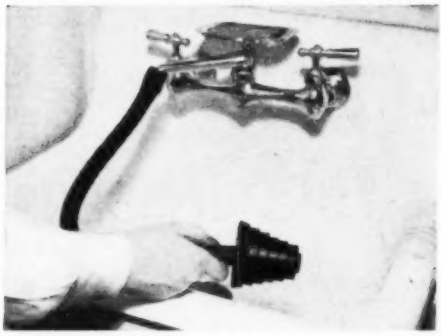
REPAIRING AWNINGS AT HOME is a quick job with this canvas repair kit. A roll of coated canvas and a can of liquid cement are provided. To repair a rent is similar to repairing an inner tube with cold patches: simply cut off a section of the roll of the size necessary to cover the torn spot, apply cement, and press firmly into place. In addition to awnings, repair work may be done on tents, tarpaulins, truck covers, duffel bags, hunting coats, and a variety of other articles made of canvas or a similar fabric. The patching roll in the kit is available in any of three colors—white, khaki, or green—to match common varieties of canvas.

BIRDS ARE KEPT FROM ROOSTING on houses and larger buildings, and the resultant defacing of walls is done away with, by the use of these bird repellers. They consist of a thin strip of brass to which are attached numerous fine-gauge brass wires, staggered at angles and designed to give the birds no place to light between them. They are installed in a row on ledges, architraves, or other places where roosting is likely, or in two or more rows where a wide ledge makes it necessary. Since they are all brass, they will not corrode and cause rust stains, and they are inconspicuous from the ground. It is said that they do not injure birds, merely discourage them, and therefore conflict with no local laws.

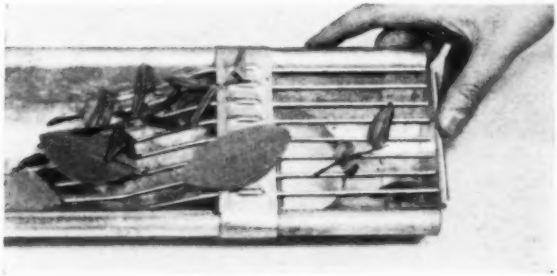


PAINTBRUSHES ARE ALWAYS CLEAN if kept in this procrastination-proof device placed on the market recently by one of the large paint companies. Called a brush keeper, it holds the used brush suspended in turpentine, or, better still, a solution of turpentine and 10 percent linseed oil. The handle fits through a rubber grip in the top of the container, which snaps tight to seal the contents against evaporation. The turpentine solution loosens particles of paint from the bristles, and they drop away free to the bottom. The messy task of cleaning and the tendency to put it off are eliminated, and the brush is fresh the next time it is needed.

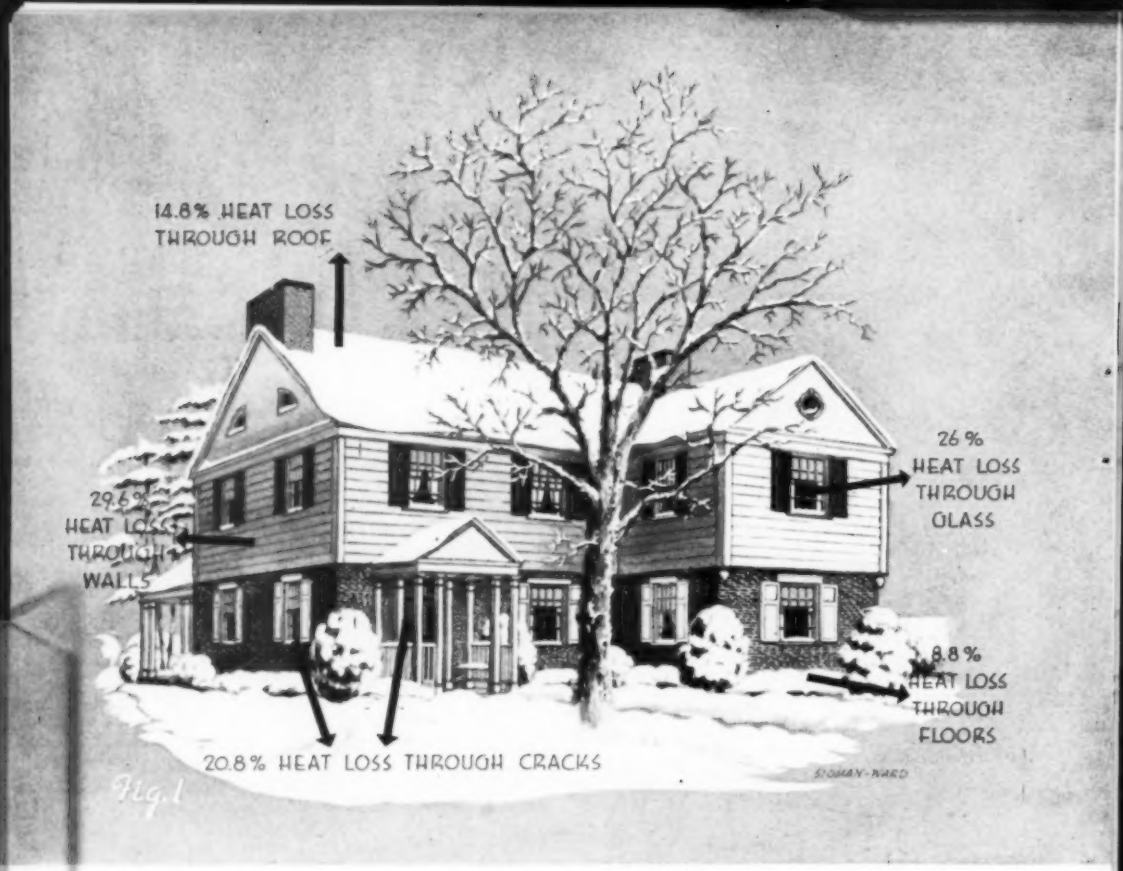
TILE, METALLIC, AND MARBLE EFFECTS, as well as matched-grain wood designs and factory-painted panels, can be obtained with this fiber wall board. It is available in 33 finishes and in sizes up to 4′ by 12′. No special tools are required for installation; the board may be sawed or cut with a knife, and it may be placed over old walls or ceilings without the necessity of removing the plaster. Cementing is recommended, but nails may be used. The board may also be placed over gypsum, wood, concrete, or wall paper, but wall paper should be scored to assure a good bond with the adhesive.



CLEARING SLUGGISH DRAINS without chemicals is possible with this rubber tube and its cone-shaped end, ridged to fit snugly into any size washbasin or sink drain. The device steps up water pressure by concentrating the flow at the mouth of the drainpipe. Usually running cold water through it for a few minutes will clean the average drain, but if it should still prove sluggish, hot water may be used instead.



PREVENTING LEAVES FROM CLOGGING rain spouts is accomplished effectively with a new type of trough shield fitted with fingers that cause the leaves to be washed up and out of the gutter. Rain water flows under the leaves, floating them up the inclined fingers. If some should happen not to be washed over the edge, they would become stranded on the horizontal bars forming the upper part of the shield, where they would be kept from becoming a water-soaked dam in the flow of the water. The new shields are made to fit either gutter-type troughs or the half-round eaves type.


14.8% HEAT LOSS THROUGH ROOF
29.6% HEAT LOSS THROUGH WALLS
26% HEAT LOSS THROUGH GLASS
8.8% HEAT LOSS THROUGH FLOORS
20.8% HEAT LOSS THROUGH CRACKS
SIGMAN-WARD
Fig. 1

Where heat escapes from the average house. The figures represent percentages of the total heat loss

How to Cut Fuel Bills by Reducing Heat Losses

By CARL T. SIGMAN AND WILLIAM J. WARD, JR.

DURING the gaslight era, only a few decades ago, western Pennsylvania had so much natural gas that communities there found it cheaper to let street lights burn all day than to hire men to turn them off each morning. Today the situation is very different. Not only are all fuels expensive, and likely to become more so, but a shortage of fuel oil is indicated. Such a shortage may bring an increase in the price of coal and coke as well as oil. Faced with this possibility, what can the home owner do to keep his fuel bills down to the minimum?

His first step may well be to clean out the furnace, adjust the oil burner, check the operating economy of his stoker, and take whatever other steps are necessary to see that the heating system is functioning at maximum efficiency. But this is far from all, and by no means the most important thing, that he can do. The next great step is to reduce heat losses, to keep warmth that represents a real dollar-and-cents value in the house, where it belongs.

It's extravagant to try to heat all outdoors. The installation of good weatherstripping, storm windows and doors, and heat insulation makes for a more comfortable, draft-free house, warmer in winter and

WHAT YOU CAN SAVE

Approximate fuel savings effected by various heat-loss preventives applied to a house originally not protected

No insulation		Weatherstripping only	15 to 20%
"	"	Storm sash and weatherstripping	25 to 30%
½"	"	No storm sash or weatherstripping	20 to 30%
½"	"	Weatherstripping only	About 40%
½"	"	Storm sash only	About 50%
1"	"	No storm sash or weatherstripping	30 to 40%
1"	"	Weatherstripping only	About 50%
1"	"	Storm sash only	About 60%

Approximate additional fuel savings resulting from application of various heat-loss preventives to a weatherstripped house.

No insulation		Storm sash	10 to 15%
½"	"	No storm sash	25 to 35%
½"	"	Storm sash	40 to 45%
1"	"	No storm sash	35 to 45%
1"	"	Storm sash	50 to 55%

NOTE: The estimates above were prepared by the National Bureau of Standards, Washington, D. C. Savings shown in first table are based on the amount of fuel consumed before installation of any of the heat-loss preventives mentioned; savings shown in second table are based on amount of fuel consumed in heating a weatherstripped house. In both cases, aggregate area of windows and doors is assumed to be one fifth of the total side-wall area.

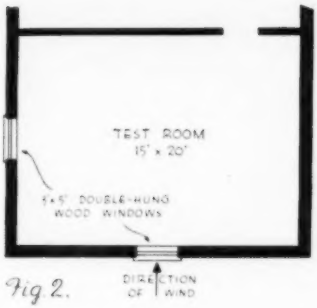


Fig 2.

—strangely enough—cooler in summer. It may lengthen the life of the heating system, or permit the use of a smaller system than would otherwise be necessary. Should you ever wish to dispose of your property, good insulation will prove a strong selling point.

Because money spent to eliminate heat losses is repaid in fuel savings, it would be hard to make a better investment in home improvement at any time, and especially at present. Furthermore, low-interest loans can still be obtained from the FHA for this purpose.

From the home owner's standpoint, the question is not so much whether to invest in storm windows, weatherstripping, and insulation, but which of these improvements will save most fuel for the money invested. Although a certain installation may save you 30 percent in fuel, it does not follow that spending twice as much for heat insulation will save you 60 percent. The accompanying chart, "What You Can Save," which was prepared by the National Bureau of Standards, shows the average savings you should realize from various methods of eliminating heat losses. It should be understood that these figures apply to complete installations in each case,

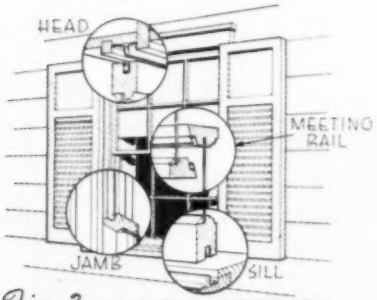


Fig. 3. INTEGRAL WEATHERSTRIP SHOWING SECTIONS THROUGH HEAD, MEETING RAIL, JAMB, AND SILL

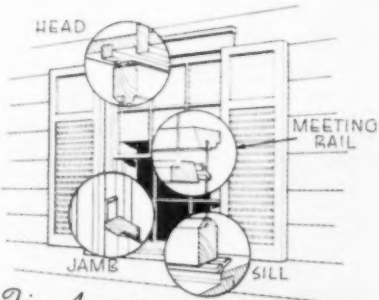


Fig. 4. APPLIED WEATHERSTRIP SHOWING SECTIONS THROUGH HEAD, MEETING RAIL, JAMB, AND SILL

and cannot be accepted for partial ones.

Figure 1 illustrates graphically how and where part of your heating dollar is lost. The average percentages given were calculated by the American Society of Heating and Ventilating Engineers after tests on 400 houses, of which 100 were weatherstripped and a few insulated.

Two factors must be considered in preventing loss of heat: first, the infiltration of cold air through cracks or other openings; second, the transmission of heat through walls, windows, roofs, and so forth. Heat transmission may occur through radiation, convection, and conduction, and increases in direct proportion to the difference between the temperature outdoors and that inside the house.

Fig. 5.
COMBINATION STORM AND SCREEN DOOR

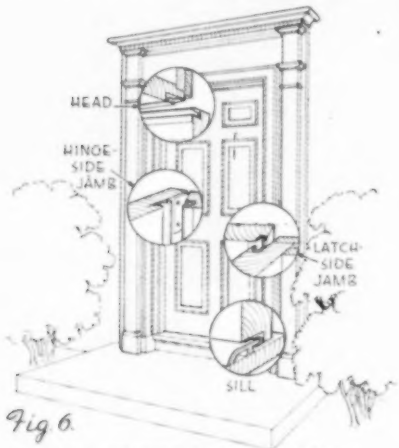


Fig. 6.
INTEGRAL WEATHERSTRIP FOR DOORS

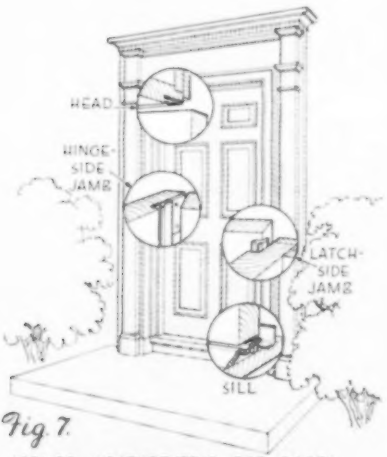


Fig. 7.
APPLIED WEATHERSTRIP FOR DOORS

Less obvious but equally important is the enormous increase in heat loss that comes with rising wind velocity—a factor not always considered by the layman. Paul D. Close, of the A. S. H. V. E., measured infiltration and transmission losses in a room 15′ by 20′ having two unlocked 3′ by 5′ windows without weatherstripping. A diagram of the test room is shown in Fig. 2. Measurements were made at various wind velocities, from zero to 30 m.p.h., and at temperature differences between indoor and outdoor air of from 20 to 100 deg. F. The results were remarkable, and go far to prove the case for weatherstripping, storm windows, and caulking.

To maintain the temperature inside the room at 70 deg., it was found, for example, that almost as much additional heat would be required during a 30 m.p.h. wind, with the outside temperature at 20 deg. above zero, as would be necessary when there was no wind and the temperature had fallen to 20 deg. below—a drop of 40 deg. The extra heat needed at 10 deg. above, with a wind velocity of only 25 m.p.h., almost equaled that required for a temperature of 30 deg. below when there was no wind. Had the room been without windows, losses due to wind would have been almost nil.

Weatherstripping serves mainly to minimize infiltration of cold air, and may be applied or integral, the latter type fitting into the window frame itself as shown in Fig. 3. Such weatherstripping is more effective than the applied variety (Fig. 4),

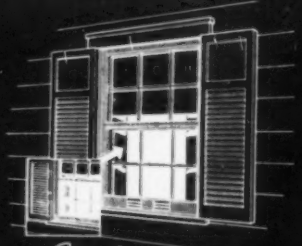


Fig. 8.
OUTSIDE STORM SASH WITH REPLACEABLE SCREEN INSERT

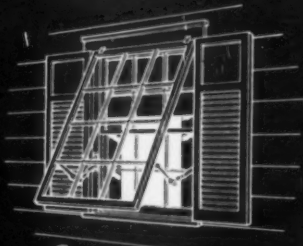


Fig. 9.
REGULAR STORM SASH WITH FRICTION ADJUSTER FOR VENTILATION

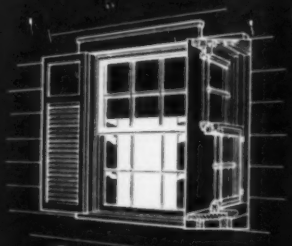


Fig. 10.
WINTER PANES FOR OUTSIDE UPPER SASH AND INSIDE LOWER SASH

but is also more expensive and cannot readily be installed by the average home owner. However, most types of integral stripping are well worth their cost, and should cut down infiltration from 50 to 80 percent.

Unfortunately, weather-tight windows bring a new problem of condensation. Moisture in the inside air may condense on them in sufficient quantity to drip on the sills or form frost on the glass in severely cold weather. Storm sash is almost essential with tight weatherstripping. The double panes will greatly reduce condensation except at extremely low temperatures. The chief function of storm sash, however, is to reduce heat losses by transmission. Dead air between the inner and outer panes acts as an effective insulation against conduction.

Many home owners feel that storm windows are necessary only in the north and west walls of the house. Worth while as such a limited installation is, storm sash for the south and east windows will pay for itself, as will weatherstripping also. For every cubic foot of cold air entering a house on the windward side, an equal amount must be expelled elsewhere. If the loss of such heated air is prevented by weatherstripping or storm sash on the leeward side, the entrance of cold air on the windward side is prevented to an equal degree. Moreover, winter winds may shift about suddenly and to a surprising degree.

Some type of storm door or vestibule should also be installed to reduce heat losses at these points, for although doors do not transmit heat as readily as do windows, they are opened much more frequently. One such door is shown in Fig. 5. Figures 6 and 7 illustrate integral and applied weatherstripping for doors. There are a number of excellent variations of these two types on the market.

Figure 8 shows an interesting type of storm sash that is also available for casements. The glass may be removed and replaced with screen inserts during the summer months. In the windows, ventilating louvers are fitted with a slide on the indoor side so that they may be opened or closed.

The type of storm sash for use in double-hung windows and inswinging casements shown in Fig. 9 is so well known it hardly requires description. Such storm windows can now be obtained with the same arrangement of panes as the interior windows, and therefore conform to the individual house better than was once the case. It is also possible to obtain packaged windows, which include not only the inside sash, but prefitted storm sash and screens as well.

An efficient type of winter sash is that shown in Fig. 10. It consists of single glass panes set into metal frames and fastened by means of thumbscrews that enter tapped inserts in the conventional sash of double-hung windows. The storm panes, as may be seen, fasten to the outside of the upper

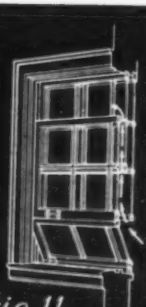


Fig. 11.
OUTSIDE STORM SASH WITH INSWINGING VENT

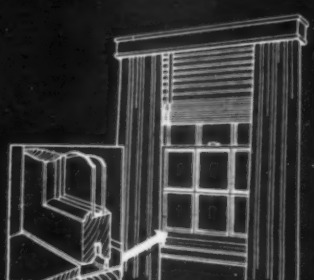


Fig. 12.
DOUBLE-GLAZED SASH

Fig. 13.
INSIDE STORM SASH, WITH VENT, FOR OUTSWINGING CASEMENT

sash and to the inside of the lower sash. They can be fitted flush by rabbeting the frames. This type of storm window is also made for steel or wood casements with sliding ventilators where required. Rubber gaskets render such sash waterproof and air-tight. They may be left in place summer and winter.

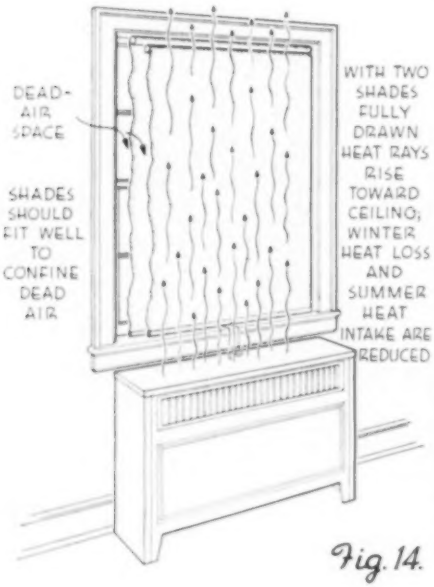
In a new type of storm sash the bottom row of lights swings inward to form an adjustable ventilator, permitting the entrance of fresh air without drafts (Fig. 11).

Instead of conventional storm windows, you can install window sash fitted with double panes (Fig. 12). This eliminates putting up and taking down storm windows each season.

Outswinging casements present a problem somewhat different from the others just discussed. They require inside storm windows fastened with clips to the window frame rather than the sash, and with rubber gaskets around them to seal in the insulating dead-air space (Fig. 13). Such storm sash also may be had with ventilators, as shown.

Not to be overlooked is infiltration of cold air through cracks around doors and windows. Compounds for caulking such cracks are available in white and colors. The work is usually done with a suitable "gun." Pack large openings with oakum or even crumpled paper before caulking.

Even window shades can reduce heat losses! The Window Shade Institute has conducted a series of experiments, in conjunction with the Armour Institute, of Chicago, Ill., in which it was found that two shades at each window have considerable insulating value. Reversing the roller of one shade as shown in Fig. 14 creates a 1" thick dead-air space between the shades. Closed Venetian blinds also have insulating qualities.


DEAD-AIR SPACE
SHADES SHOULD FIT WELL TO CONFINE DEAD AIR
WITH TWO SHADES FULLY DRAWN HEAT RAYS RISE TOWARD CEILING; WINTER HEAT LOSS AND SUMMER HEAT INTAKE ARE REDUCED
Fig. 14.

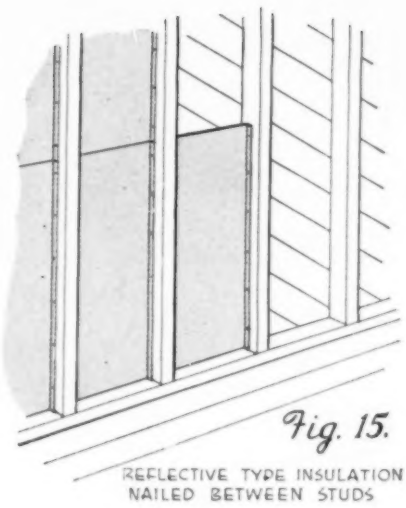


Fig. 15.
REFLECTIVE TYPE INSULATION NAILED BETWEEN STUDS

Tests conducted at an experimental three-story frame residence of the University of Illinois at Urbana, Ill., are especially enlightening. The house was heated by a warm-air furnace through a forced-air system, and the furnace was fired by an underfeed coal stoker.

Measurements were made, over a period of years, of heat losses, fuel consumption, room temperatures, flue gas temperatures, and so on. The house was at first uninsulated and had only ordinary windows. Identical measurements were then made with storm sash but without insulation, later on with insulation but without storm sash, and finally with both installations. The results of these experiments, conducted and published by A. P. Kratz and S. Konzo, led to the following conclusions:

Good insulation resulted in an actual fuel saving of 30 per cent. The installation of storm windows afforded an additional saving of 15 percent in fuel consumption. Apparently more benefit was derived from insulating the second and third stories than from insulating the first. With indoor and outdoor temperatures different by 80 deg., the temperature of the inside surfaces of exposed walls was about 11 deg. higher after the house had been insulated.

The furnace used in the test residence

had sufficient capacity to heat the uninsulated house when the outdoor temperature was as low as —10 deg. F. The amount of coal necessary to do so, burned in the same heating plant after insulation had been installed, would have been enough to keep the house equally comfortable with the outdoor temperature at about —44 deg.

To the home owner, insulation means sufficient reserve heating power to provide for extraordinarily low temperatures. To the home builder, it can mean money saved on the initial cost of the heating system, which can be smaller than would be permissible if the house were uninsulated.

Even partial insulation is worth while. Perhaps the most effective installation is between the second-floor ceiling joists (Fig. 16), if the attic is an open one. You can use a loose type of insulating material that is blown in under pressure, or you can lay insulation batts or blankets. If the attic is floored, it may be best to nail batts or blankets between the rafters. Instead of this, or, better still, in addition to it, any of several types of good insulating wall boards may be nailed to the rafters. Their effectiveness is usually in direct proportion to their thickness.

A third effective installation is between the vertical studs. The material can be blown in under air pressure through temporary holes made just below the eaves of the house. However, one disadvantage of insulation blown into walls is that it may absorb moisture in cold weather. Because moisture seeps through lath and plaster, insulation batts and blankets are today protected by the use of asphalt-base waterproof paper. During the summer, unless the house was built with waterproof paper over the sheathing, moisture may enter from the more humid air outdoors. Waterproof building paper between the lath and the insulation reduces moisture absorption greatly. If such paper cannot be used, some provision should be made for ventilating the space between the studs.

Figure 17 illustrates a very satisfactory installation of blanket insulation protected on both sides with waterproof paper and nailed between the studs in such a way as to leave dead air spaces between the lath and the insulation and between the sheathing and the insulation.

Probably the most popular type of insulating material is rock wool, which is made by melting a high-silica limestone at about 3,000 deg. F. and blowing it with steam into a fibrous material that consists 90 percent of dead-air cells. Besides this, mica pellets, balsam wool, and other fibrous materials, chemically treated to make them fire-, vermin-, and termiteproof, are often used, as well as a blanket type of insulation made of *Zostera marina*, a marine plant.

The home owner may well consider also the advantages of the reflective types of insulation such as shown in Fig. 15. These consist of thin sheets of aluminum, copper, or iron that, when nailed between studs or rafters, reflect 95 percent of radiant heat. Summer heat is reflected away from the house, and winter heat back into the house.

The layman is not likely to go far astray in the installation of storm sash or weatherstripping, but he would do well to get expert advice before purchasing insulation. Although all types have merit, it pays to obtain qualified help in selecting the best installation for any particular dwelling.

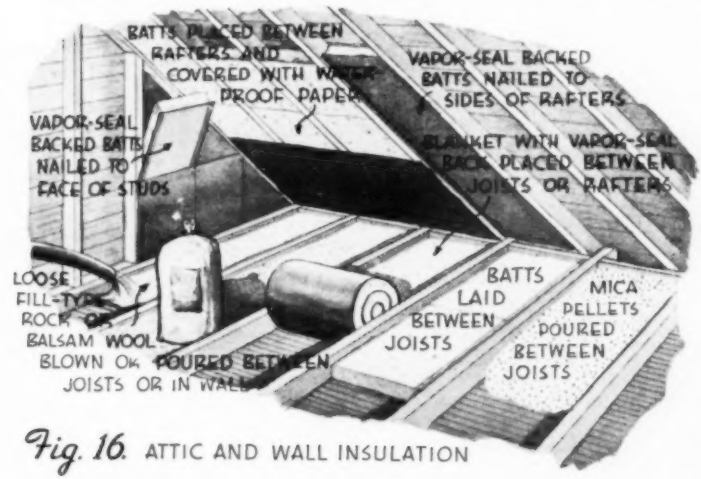

BATTS PLACED BETWEEN RAFTERS AND COVERED WITH WATER PROOF PAPER
VAPOR-SEAL BACKED BATTS NAILED TO SIDES OF RAFTERS
VAPOR-SEAL BACKED BATTS NAILED TO FACE OF STUDS
BLANKET WITH VAPOR-SEAL BACK PLACED BETWEEN JOISTS OR RAFTERS
LOOSE FILL-TYPE ROCK OR BALSAM WOOL BLOWN OR POURED BETWEEN JOISTS OR IN WALL
BATTS LAID BETWEEN JOISTS
MICA PELLETS POURED BETWEEN JOISTS

Fig. 16. ATTIC AND WALL INSULATION

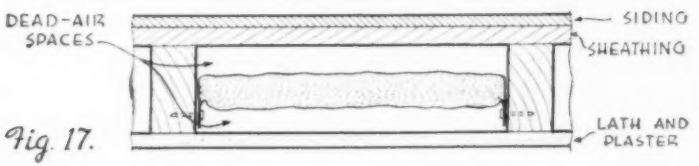


Fig. 17.

Modern Styling for a

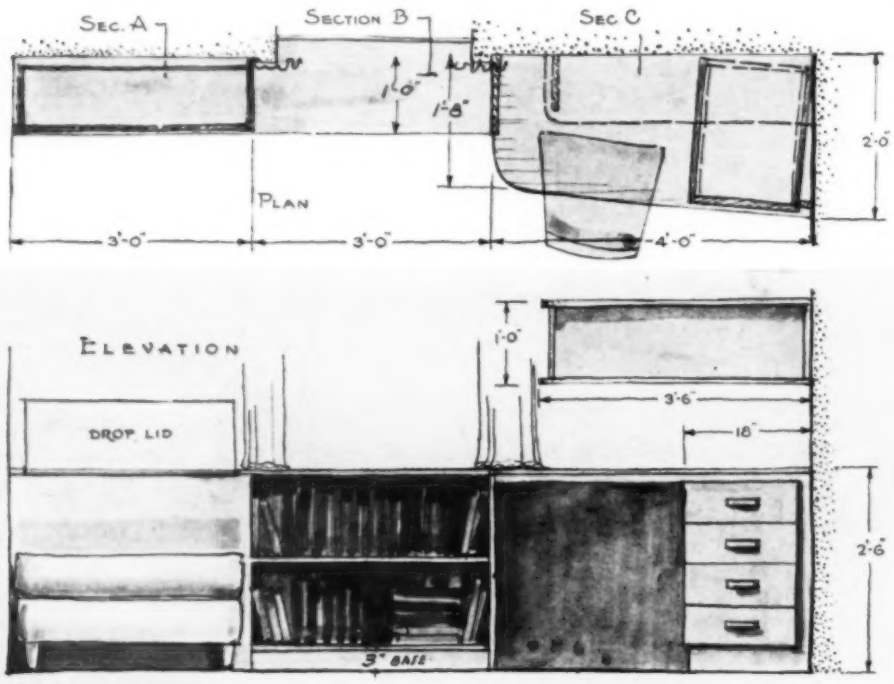
By JOSEPH ARONSON

Author of *The Book of Furniture and Decoration*

HIS very own room must be many things to a small boy—a place to sleep, study, and play as well as a repository for his personal treasures. This carefully studied design provides ample desk space near the window, where full advantage can be taken of natural light. The cleared space near the window is also there purposely for games and play. Storage space for clothing, game equipment, and other articles can be provided on the opposite side of the room in the form of a closet and a large chest of drawers.

The design can be modified as necessary to suit room proportions by changing the dimensions of the desk and bookcase, or by rearrangement of the various units. Construction can be kept simple by the use of plain pine boards and plywood panels, but the modern style of the pieces is also well adapted to a more elaborate treatment. In the original room the woodwork consisted of natural oak panels rubbed with white pigment. Blue plastic was used for the desk top, the bed cover being of a matching blue. The floor was given a spatter-dash paint finish of burnt sienna over a blue ground. Walls were painted a creamy white.

For the bed unit, a box spring and matching innerspring mattress may be mounted on a studio-couch type base having gliders affixed to the feet. The long wall panel protects the wall paper or paint. Bedding may be stored in the head panel unit, which is built out flush with the bookcase. Where the radiator is under the window, the front of this bedding box may be carried across

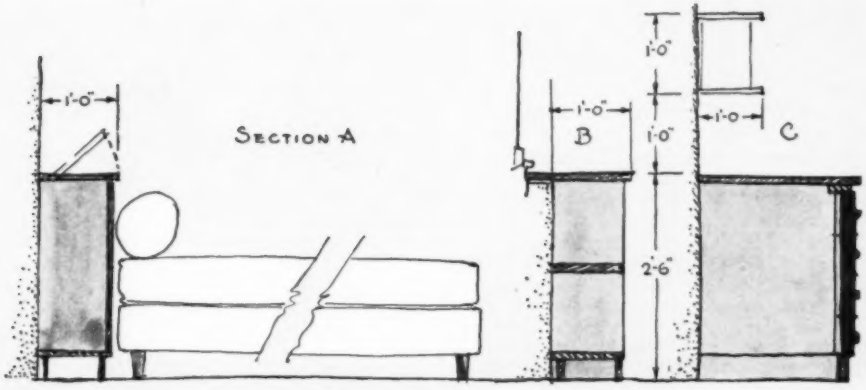


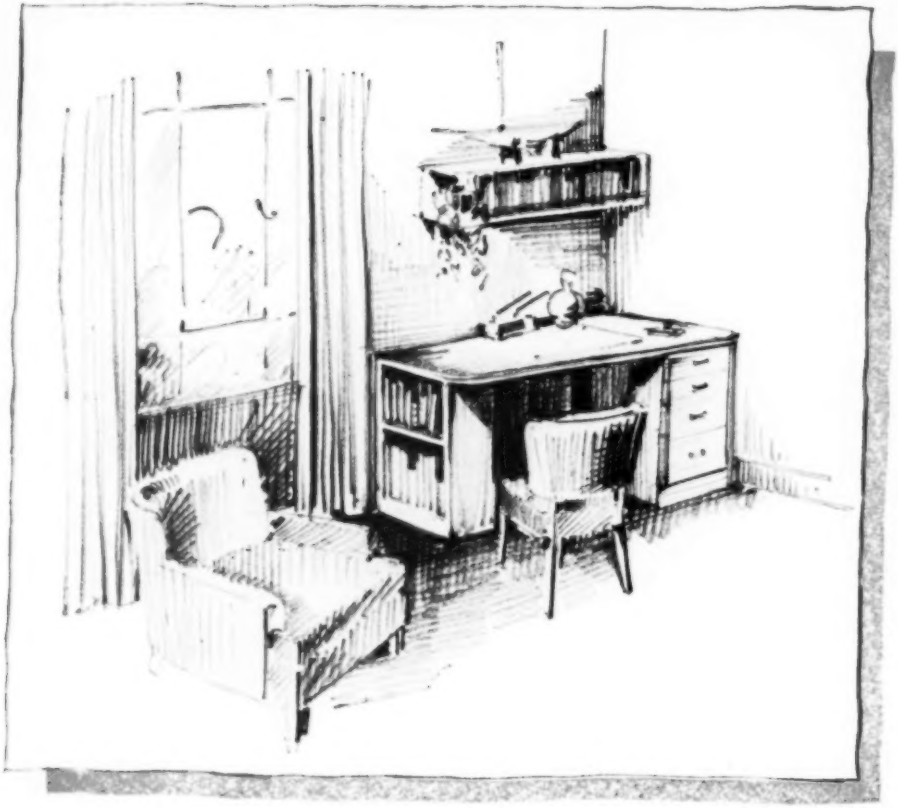
Boy's Room

it. Cut slots in the panel to permit air circulation past the heating surface.

By building the desk top so that it tapers in width toward the window, about 4" in 4', you can make full use of both light and space. The drawers are set at the same angle to avoid scraping the wall when drawn out. All the drawer fronts are allowed to project about ¾" to form a distinct secondary surface. A more detailed discussion of the desk, which also may be built as an individual piece, will be found on the following page.

The hanging bookshelf is placed in the corner above the desk. A tubular lamp and suitable shade may be affixed to its undersurface to provide light for reading and study after dark. For a neat appearance, all mounting brackets and screws should be well concealed.





Corner-Desk Construction

IF IT IS redesigned somewhat, the desk shown in the plans for a boy's room on the preceding pages makes a fine piece for the modern living room or office.

For use in a left-hand corner, the shape and the location of the parts should be reversed accordingly. A very practical bookcase supports the open end of this altered version, and the width of the drawer case has been reduced slightly to compensate for this addition.

All parts may be of ¾" fir plywood except those on which the edges are prominent, which should be of solid stock. Fir plywood can be beautifully finished in a number of ways (see P.S.M., June '41, p. 146). A more conventional wax or varnish finish on hardwood is, of course, equally appropriate.

The edges of the bookcase uprights and the front of the drawer case are flush with the 1½" thick apron around the front and left side. Let the top overhang 1" at the back and ½" on the other three sides.

Although built in at an angle as shown, the drawer case itself is square, and at precisely 90 deg. with the front edge of the desk. A panel of ¼" plywood may be rabbeted in at the right end if desired. The drawers should project uniformly to form a distinct panel surface. They are grooved for guide strips fastened to the sides of the drawer case.

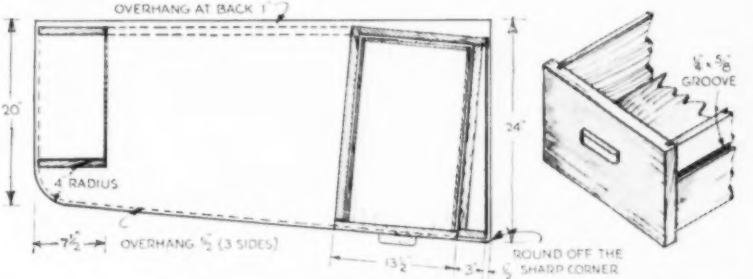
An enamel finish also may be used on the desk, and the top covered with artificial leather to harmonize with certain types of interiors.

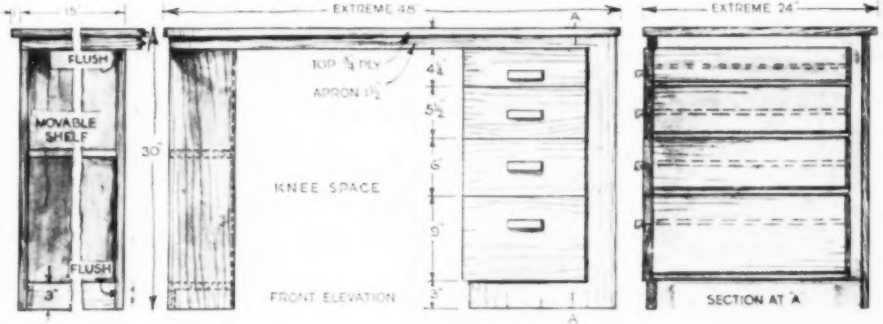
Make the auxiliary wall shelf of the same stock if possible, and hang it with the lower edge 12" or more above the desk top.

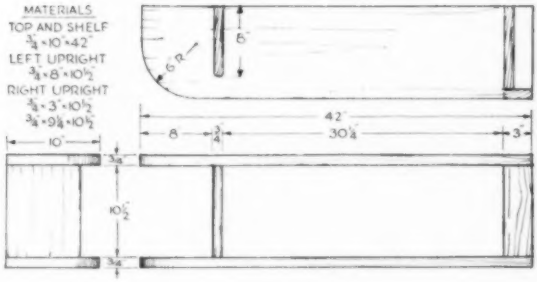
LIST OF MATERIALS

No. Pc.	Description	T.	W.	L.
1	Top	¾	24	48
1	Front apron	1½	4	44
1	Side apron	1½	2	15
1	Back filler	⅞	1½	26
2	Bookcase uprights	¾	7	29¼
1	" floor	¾	6	13½
1	" baseboard	¾	3	13½
1	" shelf	¾	6¾	13½
1	" back (plywood)	¼	14	29¼
1	Drawer-case side (left)	¾	21	29¼
1	" inner side	¾	19¾	29¼
1	" back	¾	14	29¼
1	" end (plywood)	¼	20½	29¼
1	" front upright	¾	3	29¼
1	" baseboard	¾	3	13½
1	Top-drawer front	¾	4¼	13½
1	Top-drawer back	½	3⅝	12⅛
2	" sides	½	4¼	20
1	Drawer front (No. 2)	¾	5½	13½
1	" back	½	4⅞	12⅛
2	" sides	½	5½	20
1	Drawer front (No. 3)	¾	6	13½
1	" back	½	5⅜	12⅛
2	" sides	½	6	20
1	Drawer front (No. 4)	¾	9	13½
1	" back	½	8⅜	12⅛
2	" sides	½	9	20
4	Drawer bottoms (plywood)	¼	12⅛	20⅛
4	Handles	⅞	⅞	4
8	Drawer guides	¼	⅝	20

NOTE: All dimensions are given in inches and are finished sizes.







These drawings and the illustration on the facing page are by Joseph Aronson. Ample knee space and a generously-proportioned top are provided in this design

WHAT YOU CAN DO WITH A Power Jointer

PART TWO • BY EDWIN M. LOVE

Surfacing is an important jointer operation. Push blocks are useful in working thin stock. Note the blade guard in photograph above

BESIDES the basic operations of jointing, squaring, beveling, and rabbeting described in "Modern Jointers Take the Drudgery Out of Planing" (see P.S.M., Oct. '41, p. 158), a power jointer will do surfacing, chamfering, tapering, recessing, and tenoning with speed and accuracy.

How is surfacing done?

ALTHOUGH a better finish is possible on work that is no wider than the cutter head, stock of greater width also can be surfaced. If the work is narrow and already flat, pass it over the cutters for a light cut with the grain, transferring the pressure to the rear table as soon as possible. If the stock is less than 2" thick, use a push block or "mitten," such as shown in Fig. 1, in each hand. A long, narrow board can be pushed by hand until the nearer end is on the table, when the push block should be used.

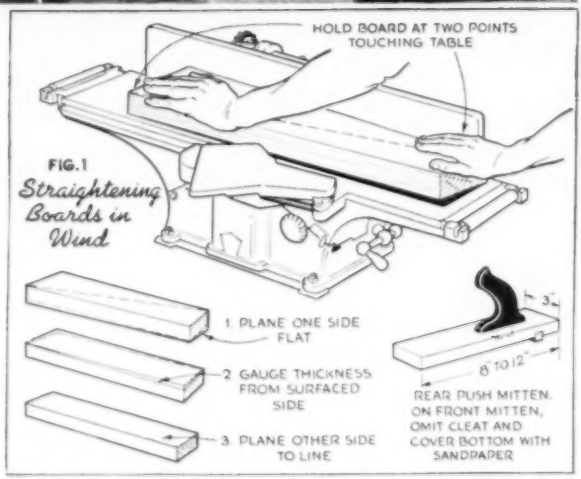
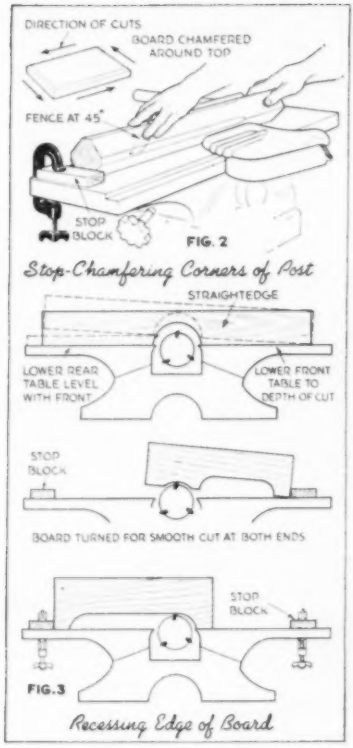

HOLD BOARD AT TWO POINTS TOUCHING TABLE
1. PLANE ONE SIDE FLAT
2. GAUGE THICKNESS FROM SURFACED SIDE
3. PLANE OTHER SIDE TO LINE
3"
8 TO 12"
REAR PUSH MITTEN. ON FRONT MITTEN, OMIT CLEAT AND COVER BOTTOM WITH SANDPAPER

FIG. 1 *Straightening Boards in Wind*

Boards wider than the cutter head are surfaced with successive cuts. It is rather difficult to avoid ridges where the cuts overlap, but with care these defects can be kept to a minimum. This operation affords a quick way to smooth rough lumber preliminary to hand planing.

If a short board is "in wind," or twisted, hold down the corners that touch the jointer table to prevent rocking until they have



In recessing an edge, both tables are lowered. Stop blocks are used to limit the length of the cut as may be required

Start of recessing cut. Work is placed against stop block on front table and gradually lowered over the cutter head

The stock is held firmly against the fence and advanced until it strikes the rear block. Note the recessed edge

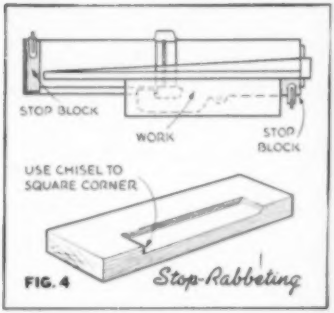
been worked down (Fig. 1). When this side is surfaced, gauge the desired thickness of the finished piece from it. Any taper or thick parts are then worked down with extra cuts, and the piece brought to size with a final full-length cut. Obviously, however, long boards cannot be straightened in this way, as their thickness would be too much reduced.

What is chamfering?

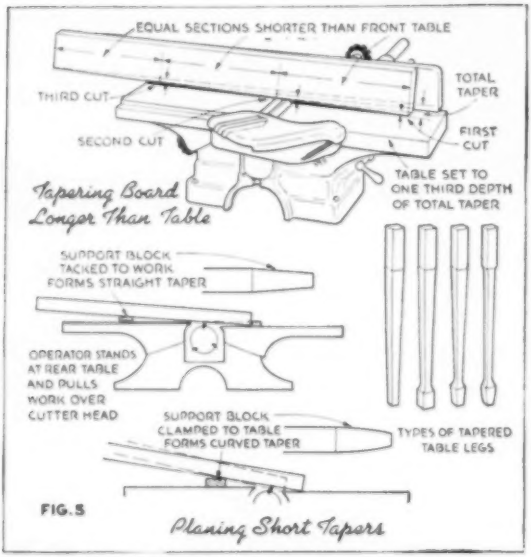
CHAMFERING is beveling off the corner or arris formed by two adjacent sides of a board. The fence is usually tilted 45 deg., and the piece is worked against it, as in jointing (Fig. 2). When several chamfers are to be made, all of the same width but too deep to allow of finishing each with one cut, make the same number of passes over the cutter head for each. When laying out chamfers, use a pencil instead of a metal gauge point, to avoid scratching the wood.

How is a stop chamfer cut?

CLAMP a block to the rear table, the fence, or the fence extension (Fig. 2), so that it will stop the work when the cham-



To form a stop rabbet, pass the work along the rabbeting ledge with stop blocks in position as required. At right, tapers are made by starting cut with end of work on rear table. The block shown prevents kick backs


EQUAL SECTIONS SHORTER THAN FRONT TABLE
TOTAL TAPER
THIRD CUT
SECOND CUT
FIRST CUT
TABLE SET TO ONE THIRD DEPTH OF TOTAL TAPER
Tapering Board Longer Than Table
SUPPORT BLOCK TACKED TO WORK FORMS STRAIGHT TAPER
OPERATOR STANDS AT REAR TABLE AND PULLS WORK OVER CUTTER HEAD
SUPPORT BLOCK CLAMPED TO TABLE FORMS CURVED TAPER
TYPES OF TAPERED TABLE LEGS
FIG. 5
Planing Short Tapers

Long tapers are planed by starting successive cuts of equal depth at predetermined points along the work, as shown above

fer has been cut as far as desired. If the chamfer is not to extend to either end of the board, the operation is the same as for making a recessed edge, except that the fence is tilted.

What is the procedure for recessing an edge?

BOTH front and rear jointer tables must be lowered so that the cutter head projects above them for a distance equal to the depth of the desired recess. This adjustment is easily made with a straightedge notched in the center to clear the knives (Fig. 3). Lower the front table, then bring the rear table to the same level by sighting against a straightedge laid across both.

Clamp a stop block on the front table or to the fence, and another on the rear table or to the fence, so that the travel of the work is limited to produce the desired recess. To start the cut, hold the nearer end of the work against the stop on the front table and slowly lower the other end against the whirling cutter head. The work is, of course, simultaneously pressed against the fence. Slide it forward slowly until it touches the other stop. If roughness on the finishing end is objectionable, stop the cut before the end is reached and turn the piece around, completing the recess with a second cut. If the unrecessed portions are unequal, the stop block on the front table must be shifted.

Is this method used for stop rabbeting?

YES. The stop blocks are used together with the rabbeting ledge (Fig. 4).

How is tapering done?

IN TAPERING, one end of the work is planed narrower than the other, as when making some types of table legs. If the

work is shorter than the front jointer table, drop the front table the amount of the taper, rest one end of the work on the rear table at the point where the taper is to start, and clamp a stop block to the front table to prevent the knives from kicking the stock backwards. Push the piece forward against the revolving cutters, keeping the nearer end down on the front table, and a smooth taper will result. If the taper is to be stopped short of the end to form a spade foot, use a stop block on the rear table. The jointer knives tend to dig in a little at the start of the taper, but a few strokes with a hand plane will eliminate any roughness at that point.

If the work is longer than the table (Fig. 5), mark it off into equal parts somewhat shorter than the front table, and lower the latter a fraction of the total taper corresponding to the number of divisions marked on the work. If, for example, there are four divisions, the table is lowered only one fourth as much as the taper desired. Make successive cuts, centering one division mark over the cutter head for each. The last cut is made the full length of the work.

When planing short tapers, it is most convenient to pull the work over the cutters while supporting the free end above the rear table with a suitable block or shim. This also is shown in Fig. 5. If the block is lightly bradded to the work the taper will be straight; if the block is clamped to the table, the taper will be slightly rounded.

What is the procedure for tenoning?

THE end of the work is rabbeted on one or both faces to the required depth, after test cuts have been made to check the adjustments. The end must bear firmly against the fence, as in Fig. 6, and the bottom face should be held down flat on the rabbeting ledge. A push block somewhat wider than the length of the desired tenon must be used to prevent splintering the rear edge of the work. If the jointer knives are dull, or if their ends project irregularly because of improper setting or sharpening, the tenon shoulders are likely to be splintered. For this reason, it is often wise to saw the shoulders, and use the jointer only to bring the tenon down to the required thickness.

Round tenons are easily cut on the ends of round stock, such as doweling, with the aid of a notched fence clamped to the rabbeting ledge. This is probably the best possible way to do this operation quickly. Lay the piece in the notch, and push it against the cutter head, parallel to the knives, until it touches the end of the notch (Fig. 6). Then turn the work slowly in the same direction as that in which the cutter head runs.

Can square stock be planed to an octagonal shape?

YES. This operation is useful not only in making table legs and other such parts, but also for dressing stock preparatory to turning it. The only additional equipment required is an auxiliary table, which the craftsman can readily make on the circular saw. A length of 2″ by 4″ stock is bevel-sawed at an angle of 45 deg. to form a V-shaped channel along its length. The sides of this channel should be at 90 deg. On the opposite face, at the center of the piece, cut away a semicircular portion to allow of placing the jig, channel side up, on the jointer tables. The cutter head should project above the bottom of the channel.

Both front and rear tables are lowered equally for the desired depth of cut, and the auxiliary table clamped to them. The square stock is then simply pushed along in the groove.

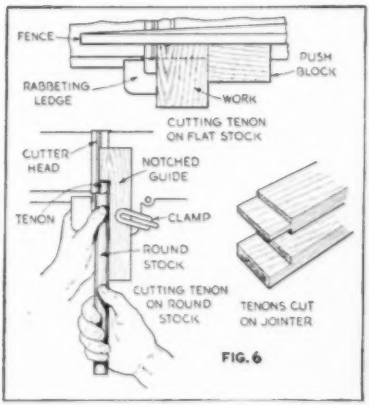
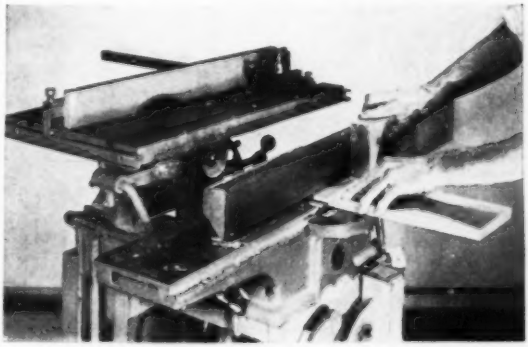


FIG. 6

Upper diagram at left and photo below illustrate how tenoning is done. To avoid splintering, use push block as shown



New Appliances

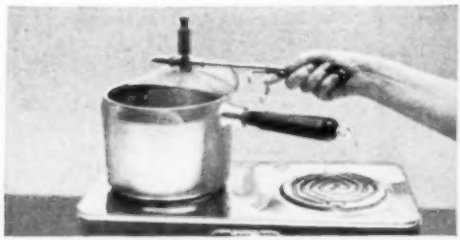
TRANSPARENT PLASTIC can be cut to fit table tops in your home with a pair of sewing scissors. It lies flat, looks like glass, and is washable, flexible, and unbreakable. It is used on chests of drawers, highboys, desks, or any kind of table, or in smaller sizes as individual mats for dining

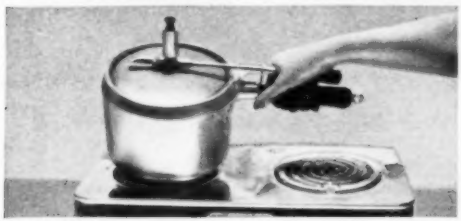
COMPANION TO THE SEWING MACHINE is this new folding sewing table. It is designed so that the machine may be clamped on it firmly, and is large enough, with its extension, to accommodate all material needed for sewing; or it may be used for cutting patterns. Steel legs fold against the wooden top for tucking out of the way in a closet

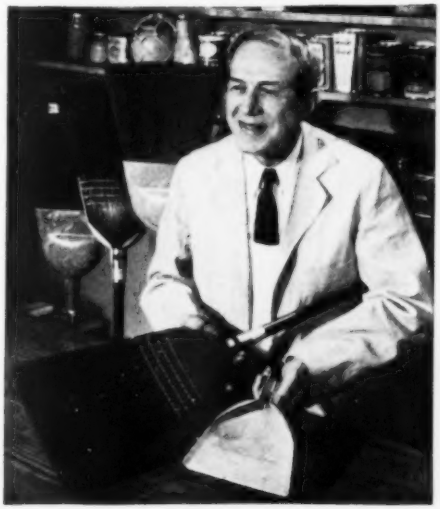
RAYS EXTERMINATE MOTHS when shot from this lamp. Infra-red rays generated by the bulb in the reflector also will kill other household insects and garden pests. They are not harmful to human beings or animals. The appliance can be operated from any outlet for A.C. current of 110 to 120 volts

for the Household

VEGETABLES AND MEAT COOK QUICKLY without water in the sealed pressure cooker shown below. Vegetables, it is claimed, are done in one half to three minutes; meats, depending on the cut, in up to fifteen minutes for the pound. Vitamins and garden flavors, it is said, are preserved, and cooking fuel saved. A timer may be had with it



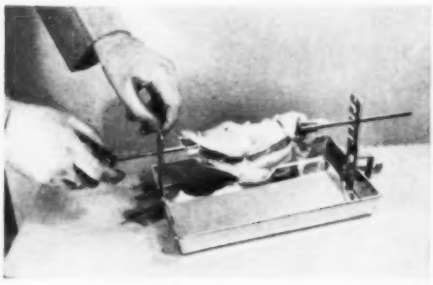


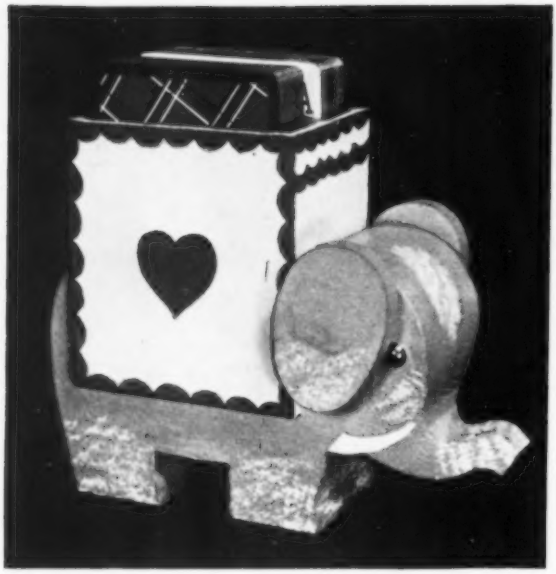


THIS DUSTPAN FITS THE BROOM and will not interfere with sweeping when left attached around the handle and top part of the straw. Made of a molded plastic, it is designed to be conveniently near whether the broom is being used or put away. The two are available in sets of matching colors

WASHING TIME IS CONTROLLED through special equipment now made for wringer-type washers (left). A dial, marked curtains, woolens, silks, overalls, or fadable materials, is set; then, at the end of the called-for washing period, the machine stops, and a pleasant chime sounds to notify the operator

A CAKE PAN IS CONVERTED into a roaster with a pair of brackets and a skewer now on the market. Basting is eliminated, and the skewer locks itself so that bird or roast may be turned on any side. An extra accessory holds steaks, hamburger, or fish. The kit comes in either nickel or chrome-steel finish





Playing-Card Holder

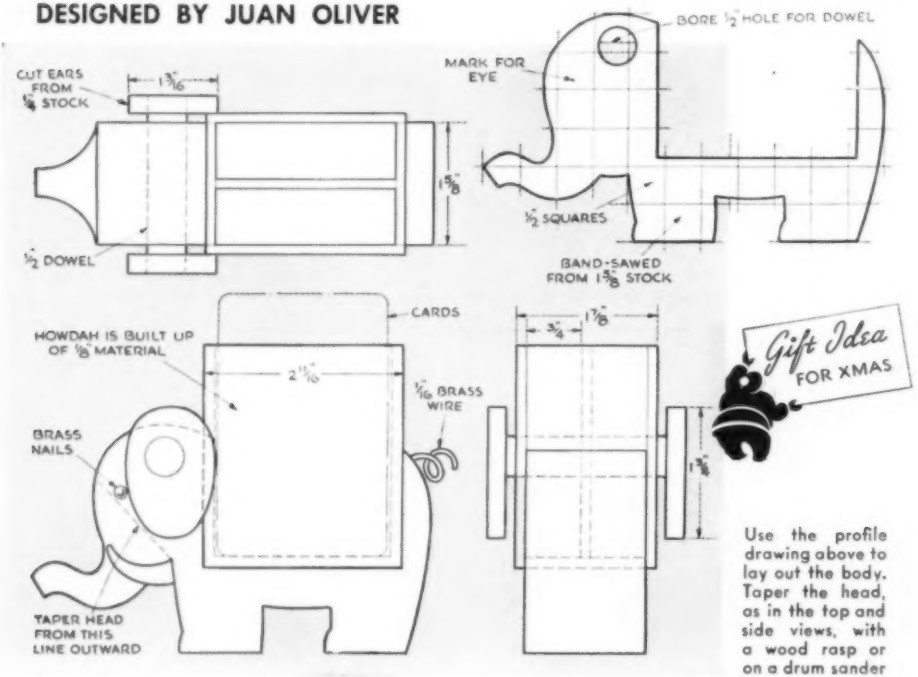
DESIGNED BY JUAN OLIVER

HERE is a gift project that combines humor and utility, yet is easy to make. The appeal of this plump little elephant is hard to resist. Filled with two decks of gilt-edged playing cards and wrapped in transparent material, the piece should prove a readily salable item for the craftsman who works for profit.

On stock 1⅝" thick (made by gluing up two thicknesses, if necessary) lay out ½" squares and draw in the profile shown. Bore the ½" hole straight through, then bandsaw the piece to line.

The boxlike howdah is built up of ⅛" plywood or composition board and glued into the body. Glue the ears in place on a length of ½" dowel. Tusks were painted on the original, but can be carved out of ¼" stock and glued on if the builder prefers.

Sandpaper the piece smooth and apply two thin coats of shellac. Japan (flat-drying) colors may be used for finishing. These can be stippled to produce an interesting texture. A spiral of brass wire forms the tail. Use two gilt tacks for eyes.



Use the profile drawing above to lay out the body. Taper the head, as in the top and side views, with a wood rasp or on a drum sander

Sandwich-Man Reminder Pad Hangs on Kitchen Wall

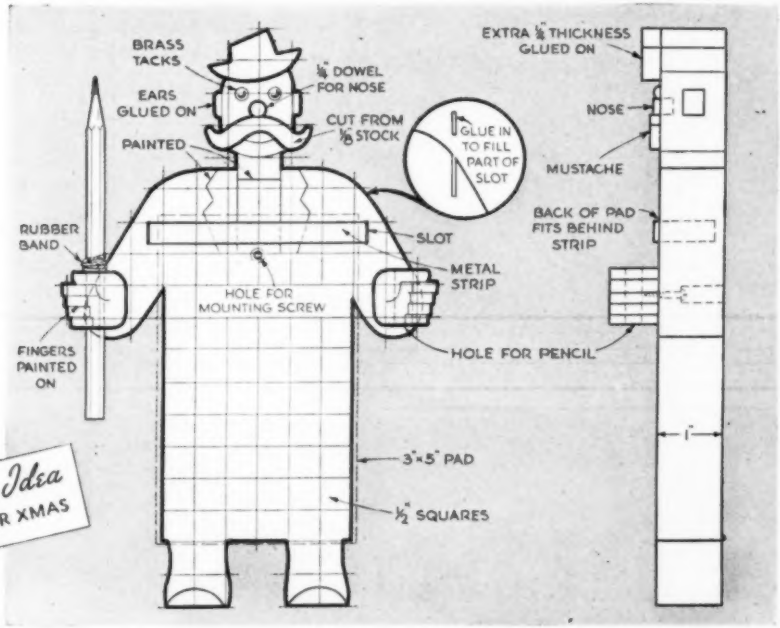
NO NEED to search for pencil and pad in the kitchen when a shopping note has to be jotted down, for this comical sandwich man holds a scratch pad ready for use and keeps one or two pencils handy.

The figure can be band-sawed from any wood about 1" thick. Run the saw blade into the shoulders to cut slots for the metal pad holder, then glue in thin strips of wood, leaving the slots about ¼" long. The back of the figure may be recessed to permit the ends of the metal strip to be bent flush with the back surface.

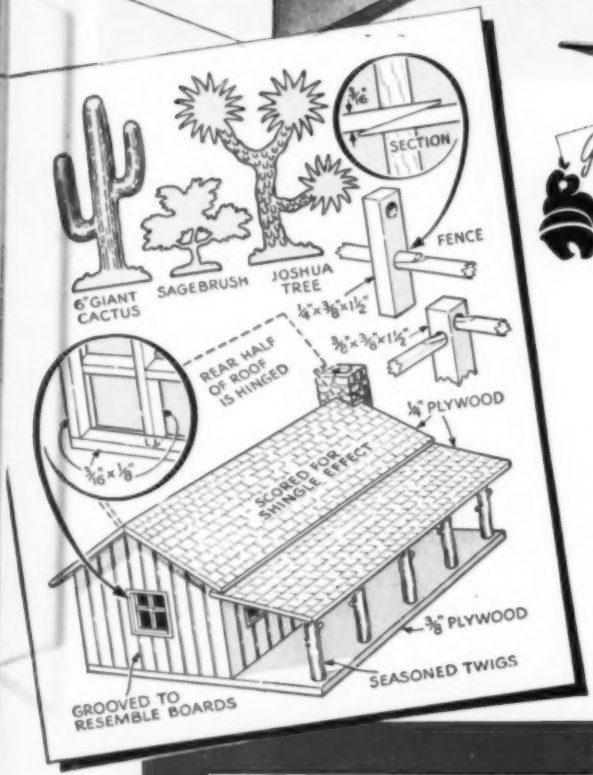
Saw out the hands, drill holes for the pencils, and fasten these parts to the body with glue and with screws countersunk from the back. A ¼" thick piece of the same shape as the hat is glued on to match it, and the mustache, cut from ⅛" thick stock, is glued and bradded in place. Drill a hole in the body so that it can be fastened to the wall with a screw.

After sanding, apply a coat or two of shellac and paint the figure with Japan (flat-drying) colors or enamel. The eyes are black or gilt upholstery tacks. Fingers, collar, and neck line are simply painted in. Insert the cardboard back of the writing pad behind the metal strip, and use rubber bands on the pencils to keep them from slipping through the hands.

Juan Oliver designed this amusing kitchen help. Cut the entire figure, except hands and mustache, from one piece. The pad hangs over a metal strip



Dude Ranch



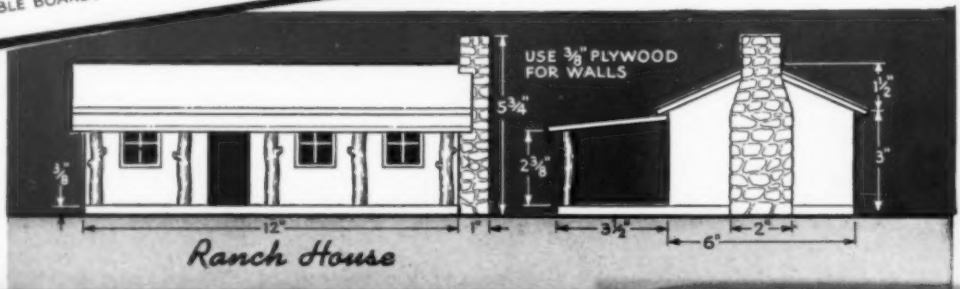
Gift Idea FOR XMAS

By HI SIBLEY

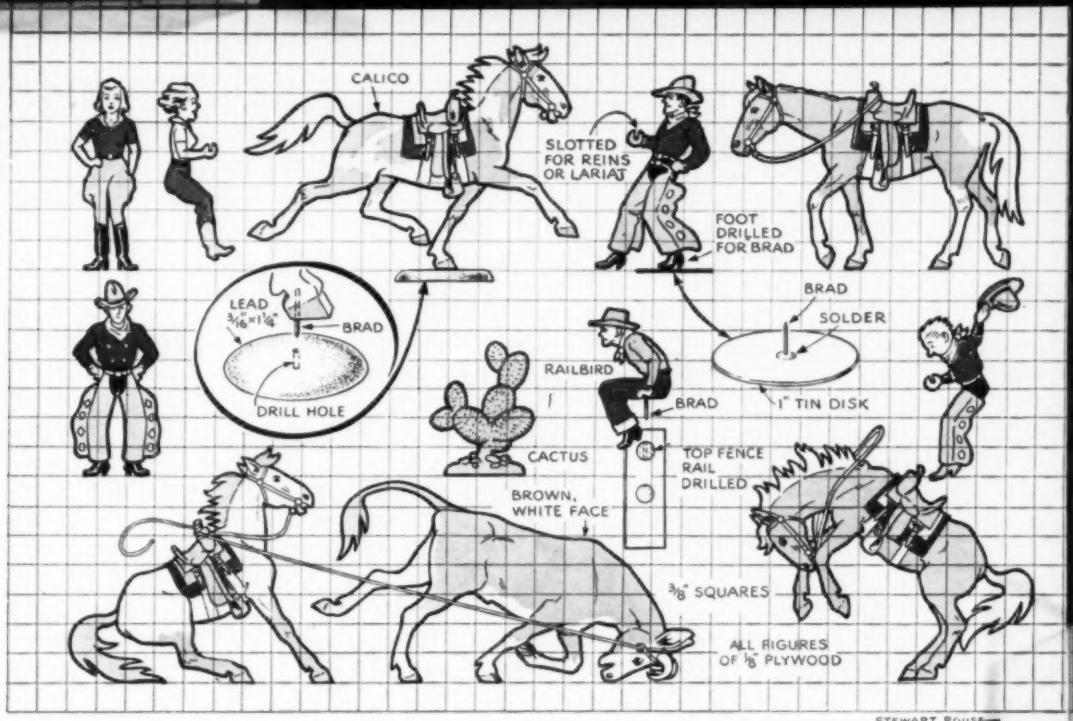
SO COMPLETE is this wooden toy ranch that it includes even the sagebrush and cactus! If made as a Christmas present for a child, it can be set up under the tree to serve as a decoration as well as a plaything.

All the animals and figures can be scroll-sawed three or four at a time from ⅛" veneer or plywood. The running and bucking horses may be mounted on lead disks to hold them upright. A brad is forced into a drilled hole in one leg of each horse, and the head of the brad is cut off. The disk is then drilled to fit the shank. Standing figures such as the cowboy may have a hole drilled in one foot to fit a brad soldered to a flat tin disk.

Railbirds perched on the corral fence are similarly mounted, the upper fence rail being drilled in this case. Note that the riding figures are made



Ranch House



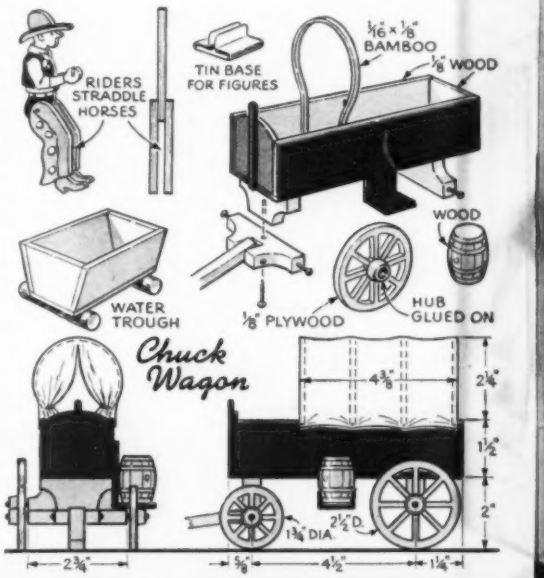
STEWART ROUSE

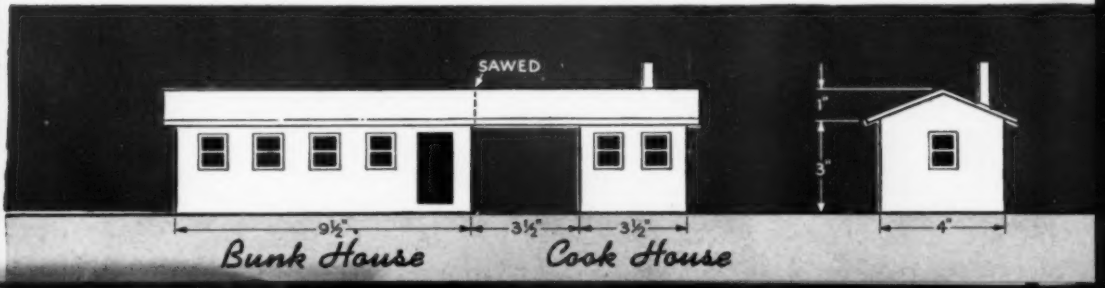
with legs bradded to the bodies on both sides, so that they straddle the horses.

The ranch house is built like any other miniature building and has a hinged roof, which permits the smaller pieces to be stored inside when not in use. The chimney stonework can be represented by painting white lines on a gray background, or, more convincingly, by first scoring the wood to represent the joints and then painting it. The bunk house is cut apart from the cook house so that both may be stored more easily.

A corral of any desired size is built of posts and dowels, the ends of which are beveled as shown for wedging against one another in the holes in the posts.

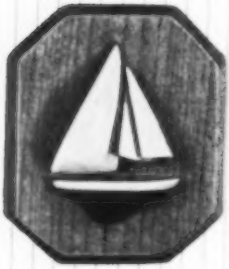
Cutting out the parts for the chuck wagon is a simple scroll-saw job. They are assembled with model-airplane cement and small brads. Cactus and sagebrush lend the final western touch to the set-up. The various animals and characters can be arranged to illustrate ranch activities such as lassoing, bronco-busting, or high-tailing it to the chuck wagon after a day on the round-up.





MINIATURE Sailboat Plaque

ORNAMENTS LAPEL PIN



THE EFFECTIVE use of contrasting woods lends distinction to this plaque pin, which makes an excellent gift and can also be readily sold. A pocketknife with a small blade, some sandpaper, model-airplane cement, scraps of wood, and a little varnish are all that is required to make it. Use any contrasting combination of woods.

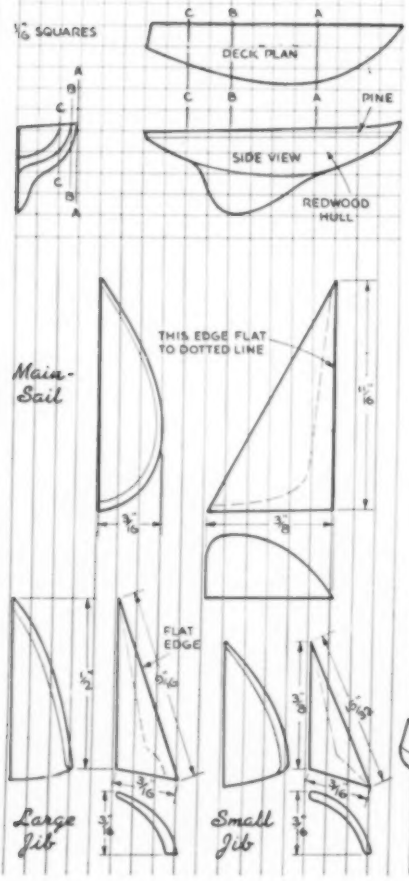
For the body or back of the pin illustrated, ⅛" by 1¼" by 1½" redwood was selected. This part may be cut to whatever shape you prefer; it could be round or oval instead of as shown. It must be sandpapered very smooth.

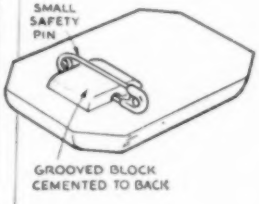
The boat hull in this instance was carved from a piece of red cedar 3/16" by ¼" by ¾". A thin chip of white pine was glued to the top of this before it was whittled and sandpapered to the shape shown.

All the sails were carved out of 3/16" thick white pine. The outside of these was shaped first; then they were hollowed from the back. Note that one edge of each of the three sails is left flat for cementing to the back of the plaque.

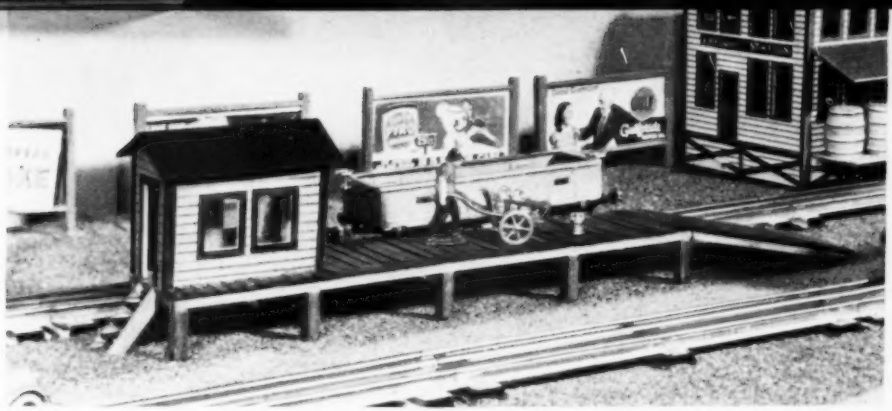
Finish all surfaces smooth with very fine sandpaper or silicon-carbide paper before assembling. Glue on the hull and sails in the positions shown in the photograph, being careful to remove all excess glue, since even a drop will mar the appearance.

Fasten a ¾" long safety pin to the back by means of a small grooved block as shown in the drawing below. Finish the entire plaque with one or two coats of clear varnish or lacquer.—EDWARD STONE.





The hull outline can be marked on the blank by use of squares. Dotted line on each sail shows limits of flat portion



Milk Depot Adds Realism to Farm District of Model Railway

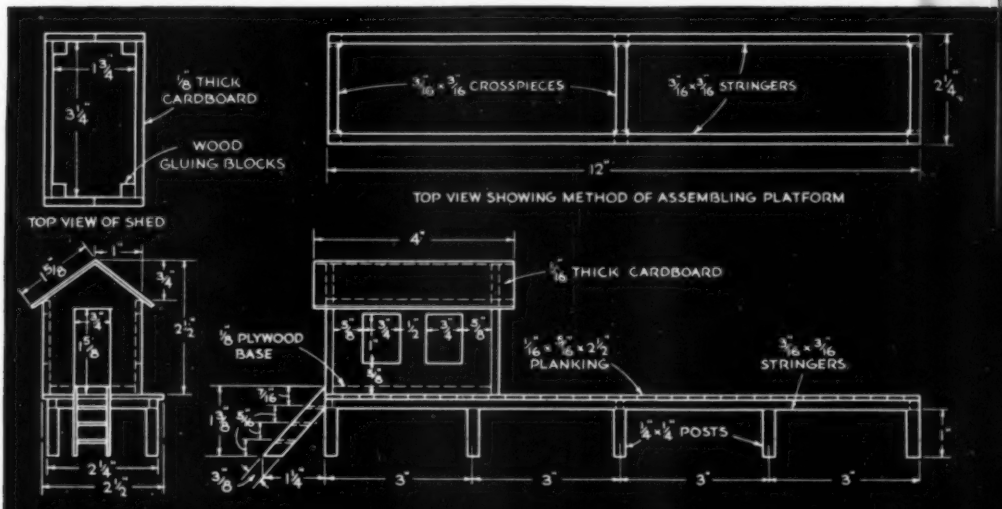
SIMPLE to construct, this milk depot is an authentic stop for the farming district of a model railway system. It is scaled for "O" gauge, but the size can be changed.

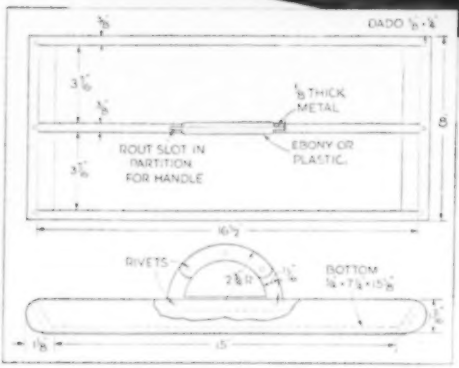
Construct the platform first, sawing all pieces to size from white pine or balsa wood. Lay the crosspieces and stringers in position and glue together with model-airplane cement. Then glue the strips of planking to the stringers and add the wood posts.

Draw the outlines of the shed walls, door, windows, and roof on Bristol board or heavy cardboard, and cut out with a razor blade and straightedge. Color or stain to represent light-brown paint; then rule thin black lines ¼" apart horizontally for clapboard. Paste transparent wrapping material over the windows on the inside, and glue on a door of thin cardboard, cementing it along one edge only. Fit the walls around a plywood base, and glue wood reënforcing blocks along all abutting edges.

Strips of heavy, dark-brown paper ⅛" wide are pasted around the windows, and strips 3/16" wide along the wall corners, to imitate wood trim. After gluing on the roof pieces, fix the shed to one end of the platform. The steps are strips cut from a berry box.

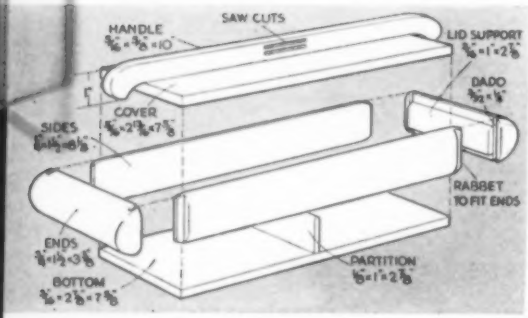
A ramp built the same as the platform top is glued to one end of the platform. Thin water stain gives the wood parts a weather-beaten appearance.—C. E. BLACK.





Walnut was used for this handsome tray, but other woods are equally effective. The ends are rounded after the frame has been glued up. Cement sheet cork into the compartments

An ebony handle sets off this walnut cigarette box



WORKING

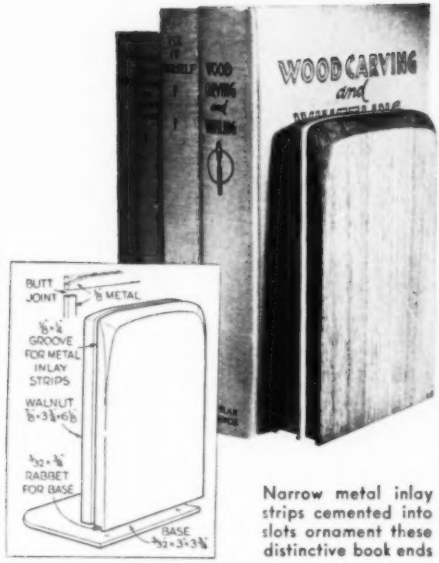
FOUR CRAFTWORK PROJECTS

THE CRAFTSMAN who begins work early can have an array of useful and distinctive gifts ready before Christmas, and avoid the usual last-minute rush. Here are two items for men and two for women—modern, smartly styled, sure to prove acceptable.

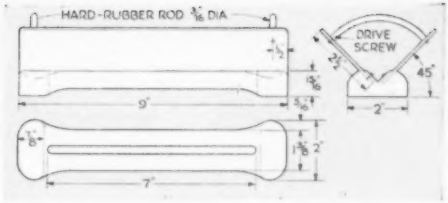
SANDWICH SERVICE TRAY. What hostess could fail to appreciate this two-compartment sandwich and *canapé* server? All parts are of ⅜" stock except the bottom, which is ¼" thick, and the ends, which are ripped from 1¾" material at an angle as shown. The sides and partitions are rabbeted to fit dados in the ends, but the bottom is simply beveled to fit between them.

Cut the handle from ⅛" scrap aluminum, copper, or brass and fasten it with small rivets in a ½" deep mortise routed into the partition. The side-pieces, of ebony or plastic, are also riveted on. After the handle has been attached and the bottom glued in place, the partition also is glued in.

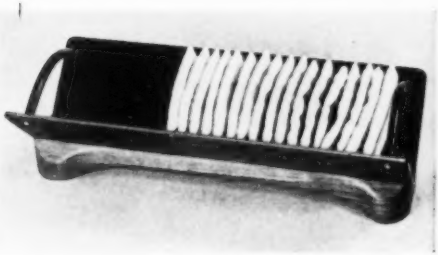
Finish with two coats of thin, clear lacquer, rub down with fine abrasive



Narrow metal inlay strips cemented into slots ornament these distinctive book ends



Black plastic and walnut, or other contrasting materials, may be used for this novel table accessory



TIME: ONE EVENING

DESIGNED FOR POPULAR SCIENCE BY ERNEST R. DEWALT

paper, and finally wax and polish the piece. Approximate time, 4½ hours.

DE LUXE CIGARETTE BOX. Ideal for a man's desk because of its generous proportions and masculine modern styling, this box can be made wide enough for long cigarettes if desired. Straight-grained walnut is used. Cut all four rabbets on the two sides at one time for uniformity's sake. The ends are dadoed to fit, and the frame is glued together squarely. Fit in the bottom and the two pieces at the ends that form the lid rabbet, as well as a partition in the center.

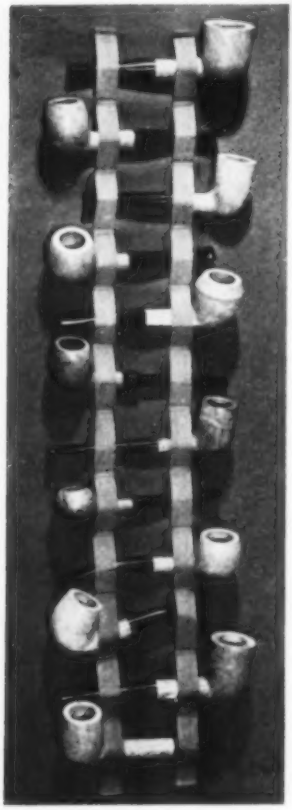
After the glue has thoroughly set, shape the box by planing or sanding it to the form shown. The top is a simple rectangle 5/16" thick. For contrast, the handle should be made of ebony or black plastic. Its lower edge is shaped to conform to the ends of the box. Fasten it with brads or screws and glue.

The box illustrated was given two coats of clear lacquer, sprayed on, and treated like the sandwich tray. Time, 4 hours.

WALNUT BOOK ENDS. These will remain serviceable and attractive a long time despite hard usage. Cut two pieces of walnut to size and groove them on three sides for the metal inlay strips. Rabbet the bottom edge for the base pieces. Scrap aluminum was used for the book ends illustrated, but pewter, brass, or copper are equally appropriate. Roughen the metal strips for a better bond and press them in place with casein glue or model-airplane cement. On a garnet-faced sanding disk, shape the top and sides of the wood as shown, sanding the metal inlays flush at the same time. Attach the base piece with wood screws, and finish with thin shellac, rubbed down and waxed. Time, 3 hours.

CRACKER OR TOAST RACK. Walnut and phenol-formaldehyde plastic were used for this useful piece. Rip the wood base on the circular saw to the cross section shown, then shape on a band saw and sand. Rout or jig-saw out the center slot. Fasten the sides together for drilling. Heat 3/16" thick hard-rubber rod in water to bend it to shape for the cross members. Holes are predrilled in the various parts for small drive screws. Wax the base, and assemble. Approximate time, 4 hours.

His brier selected, Mr. Graham, at right, squares two sides of the block as the first step in turning one of his beautifully finished pipes. Several of the designs he makes are shown in the photograph below, and one of decoratively grained brier above. He works in a shop at home, and uses an ancient lathe



Pipe Making

Joseph W. Graham, whose hobby is now a business, shows how the home craftsman can turn a block of brier into a handsome, sweet-smoking pipe

PROBABLY every craftsman who is a pipe smoker feels at some time or other the urge to try his hand at pipe making. It was such an impulse that started Joseph W. Graham, of White Plains, N. Y., in the hobby that became his business in 1937, when he was unable to find work in his capacity of production engineer. In the tiny workshop on the second floor of his home, Graham has turned out as many as 3,000 pipes in one year, all of them made on a huge, ancient lathe of a type patented in 1874. Despite this respectable volume of business, he still uses home-made chucks and other improvised equipment.

With such simple accessories as he can devise for himself, any lathe owner can make pipes for his own use and as gifts. The beginner will do well to copy a straight-stem

pipe for his first attempt, calipering the dimensions directly from it. Later on, he can experiment with designs of his own or attempt more difficult shapes. Graham rarely uses drawings or templates except for special models, but works from samples when he makes his regular styles.

The first step after selecting a brier block is to square up at least two sides of it. This can be done quickly on a disk sander, as shown in Fig. 1. The surfaces should be flat for accurate chucking.

Next, the block is carefully marked as in the first drawing. A square will serve, but the simple jig illustrated speeds the work when several pipes are to be made.

A special pipe-maker's chuck, a four-jaw independent chuck, or a homemade one such as Graham uses (Fig. 2) is needed to mount the block. A plain or a slotted faceplate can be adapted to the purpose by fitting it with four studs having pin screws.

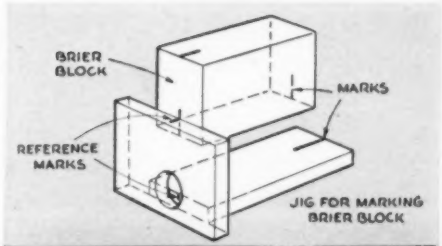
The block is chucked with a hardwood wedge between it and the faceplate as shown in Fig. 2. This wedge produces the characteristic "taper" or slant of the bowl that lends character to the pipe. The amount of taper may vary with style, but a pipe with none at all, that is, with the bowl at 90 deg. to the stem, would have an odd, unsatisfactory appearance.

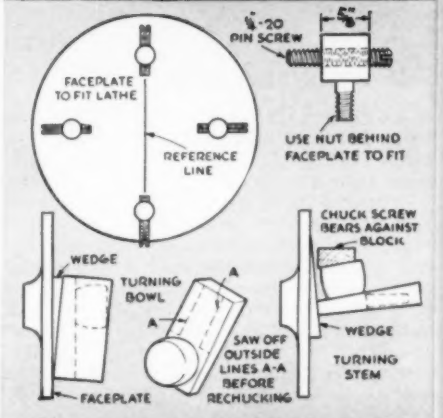
Mount the block with its center line on the diameter of the faceplate, which may be marked to facilitate alignment. Tighten the pin screws or chuck jaws and check them occasionally during turning to make sure they do not work loose.

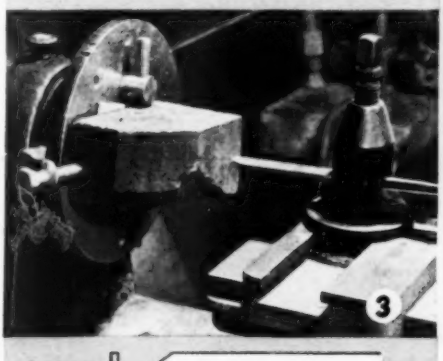
The hole in the bowl is turned out first. It may be started with a ½" drill bit and finished to size and shape with a special tool such as is shown in Fig. 3. This was ground from an old flat file and sharpened to a razor edge. A scraping cut is used in all turning operations, the tool edge being set on the center line of the lathe spindle.

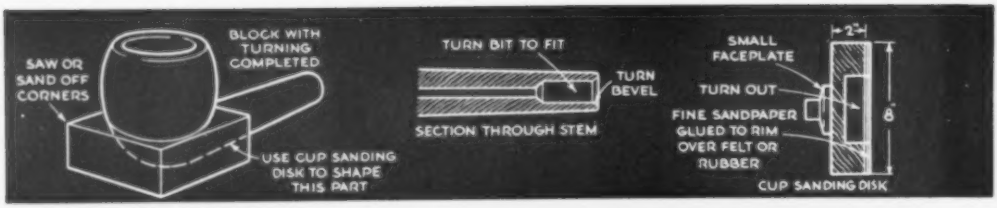
The same or a similar tool is used in the slide rest to rough-turn the outside of the bowl as far down as possible. The unturned part of the block must be left thick enough to allow turning the stem from it. When much material is to be turned down, Graham prefers the slide rest, as hand-held tools are more likely to "dig in" and tear the fiber of the tough brier.

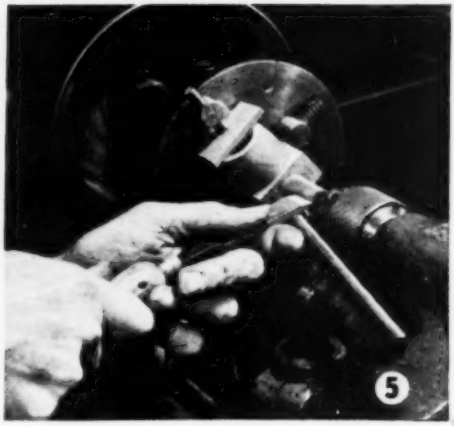
However, the final convex shape of the bowl is produced by turning it down with a tool held by hand on the conventional tool rest. Figure 4 shows this step, as well as the shape of the block at this time. Either a conventional skew chisel or one ground from a file may be used, but the cutting edge must be razor keen, for upon it depend the finish and perfection of the pipe. If the turned surface is rough, the tool is not











sharp enough. Graham whets his tools on a very fine Arkansas stone, using oil, and hones them on a piece of leather to which a little optician's rouge is applied.

When the bowl has been shaped to your liking and its top turned square, the block must be rechucked as in the drawings and in Fig. 5. Note that the same wedge is used again, this time under the remaining portion of what was the end of the block, and with the thin end under the turned part of the bowl. A second but heavier wedge-shaped block is inserted between the top of the bowl and the chuck screw bearing against it. Be sure to align the block with the original marks so that these lie along the diameter of the faceplate. Failure to do this will result in bowl and stem being off center.

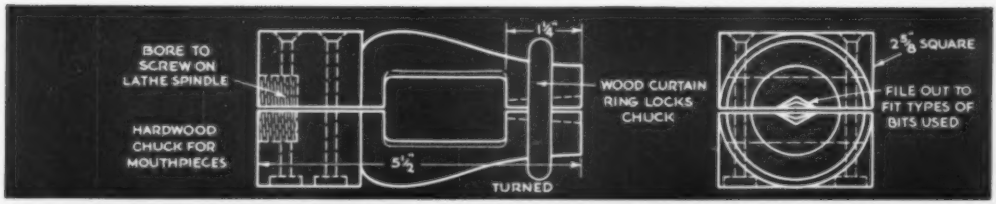
Using the tailstock chuck, bore a 9/64" hole through the stem portion into the bowl. Then counterbore with a 9/32" drill to a depth of about ¾". If a filter is to be fitted, the original hole is counterbored twice. Face off the end of the stem portion and turn out the short bevel, which may be formed quickly by holding a countersink against the stem face by hand.

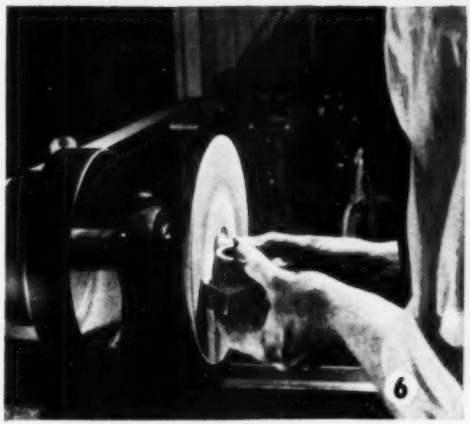
A piece of 9/32" rod is inserted in the tailstock chuck and run into the stem to serve as an arbor while the outside is being turned. Use the slide rest so far as possible, finishing the stem to the desired taper with a hand turning tool. If the maker prefers, the shoulders of the stem piece may previously be sawed off as indicated by the dotted lines A-A in the drawings so as to leave less stock to be turned down.

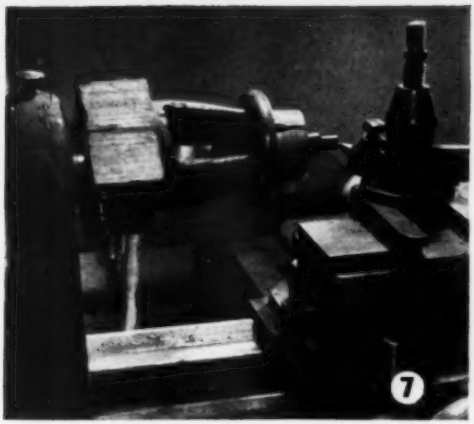
Shaping the bottom of the bowl, and the portion that joins it to the stem, is a hand operation calling for skill and a practiced eye. The excess stock is removed on a sanding wheel (Fig. 6). Graham's is a wooden disk with a nut at the center to secure the No. 2 garnet paper, which is not glued or otherwise held to the disk at any other point. He has found that such a loosely held disk conforms itself to the rounded shape of the bowl and removes material speedily without causing flat spots such as occur when the abrasive paper is cemented fast.

For the final shaping of the inner part of the bowl nearest the stem, a cup sanding disk will be necessary. This can be made on the lathe from a glued-up blank, the center being turned out to a depth of about 1½" as shown, and a thick layer of felt cemented to the broad rim. A ring of fine sandpaper is glued to the felt.

The mouthpiece is turned in a special chuck to fit the stem. A negative rake is used on the tool, which is held in the slide rest as in Fig. 7. Stem and mouthpiece are then sanded to a perfect joint on a convex, felt-backed disk covered with No. 280 or No. 320 silicon-carbide paper (Fig. 8). Any slightly roughened parts of the bowl may







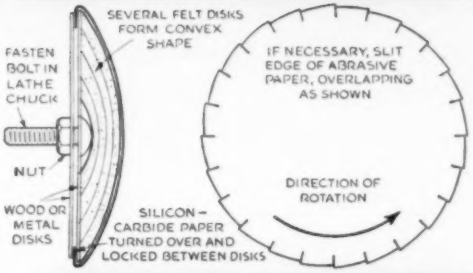
also be sanded smooth on this wheel.

For a high polish, Graham next buffs the brier on a large cotton wheel charged with tripoli, the proper grade of which is best learned by experiment. Final polishing is done on a second uncharged wheel, but if desired this may be used with carnauba wax for a high-gloss finish.

Graham uses no stains, varnish, or other finishes on his pipes, which color as they are smoked to a rich and pleasing patina. They take on a deeper tone also if aged for several months. On light-colored brier, the grain may be brought out by rubbing the pipe with linseed oil after buffing with tripoli. Lay it aside for an hour, then re-buff lightly and polish on the second wheel.

For custom-made "church warden" pipes and others of unusual design, Graham turns mouthpieces out of hard-rubber rod. These are sanded smooth with silicon-carbide paper, buffed with tripoli, and polished as described. Curved mouthpieces are shaped with the fingers after they have been carefully heated above a gas or alcohol flame.

Because of conditions abroad, the importation of brier root has been seriously curtailed. This has led to a search for substitutes. Hickory, maple, mountain laurel, and birch have been used, as well as ebony, rosewood, olive wood, and the burls of manzanita and wild lilac.

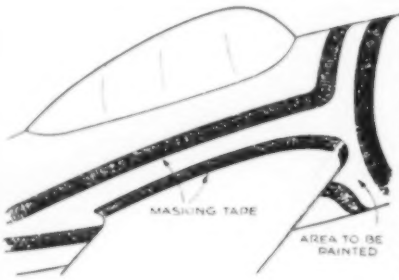

SEVERAL FELT DISKS FORM CONVEX SHAPE
FASTEN BOLT IN LATHE CHUCK
NUT
WOOD OR METAL DISKS
SILICON-CARBIDE PAPER TURNED OVER AND LOCKED BETWEEN DISKS
IF NECESSARY, SLIT EDGE OF ABRASIVE PAPER, OVERLAPPING AS SHOWN
DIRECTION OF ROTATION

Rubber Cement Sticks Cut-Out Letters on Model Airplanes

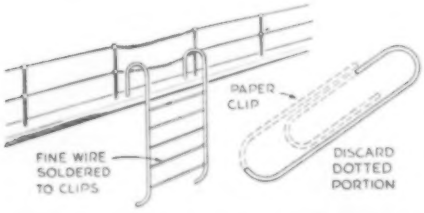
BOND PAPER
AFTER DRAWING LETTERS IN REVERSE, APPLY RUBBER CEMENT OVER ALL
BLACK LACQUER OR DOPE
PRESS CEMENT SURFACE OVER ANY FLAT SURFACE. BRUSH WITH LACQUER LET DRY BEFORE REMOVING
CUT OUT LETTERS WITH KNIFE OR RAZOR BLADE

NEAT letters and numbers of any size and color for a model plane can be cut from paper. Draw them in reverse and fasten the marked side down with one coat of rubber cement to a flat surface. This will keep the paper smooth while colored dope is applied. Let dry, peel off the paper, and cut out from the back. Use cement on both cut-outs and plane. You can then slide each letter into place while the cement is wet. Squeeze out the surplus cement from under the letter with any smooth, flat object. Rub off the surplus with the fingers.

Masking Tape Aids in Painting Models Neatly



NO MATTER how well a model airplane or other model is constructed, it will be ruined if the decorations are carelessly applied. To assure sharp outlines, use masking tape, which can be obtained in paint stores or model shops. Pat it firmly against the work to prevent the paint from creeping underneath. About two thin coats of colored dope or enamel are sufficient. More will produce a noticeably thick edge. The decorative lines are not put on, of course, until after the model has otherwise been completely finished.—F. Z.

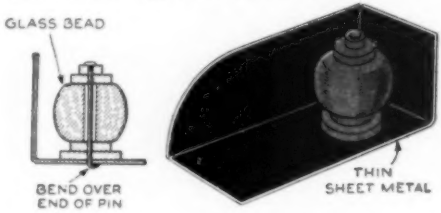


Side Ladders for Boat Models Made from Paper Clips

SIDE ladders for ship models may be made from ordinary wire paper clips to which pieces of fine wire are soldered to represent the rungs.

Colored Glass Beads Imitate Ship's Running Lights

FOR realistic mast and running lights on model ships, glass beads may be used. Bend thin pieces of sheet metal for the light mountings, and paint the inner portion the color of the bead.—PAUL H. SMITH.



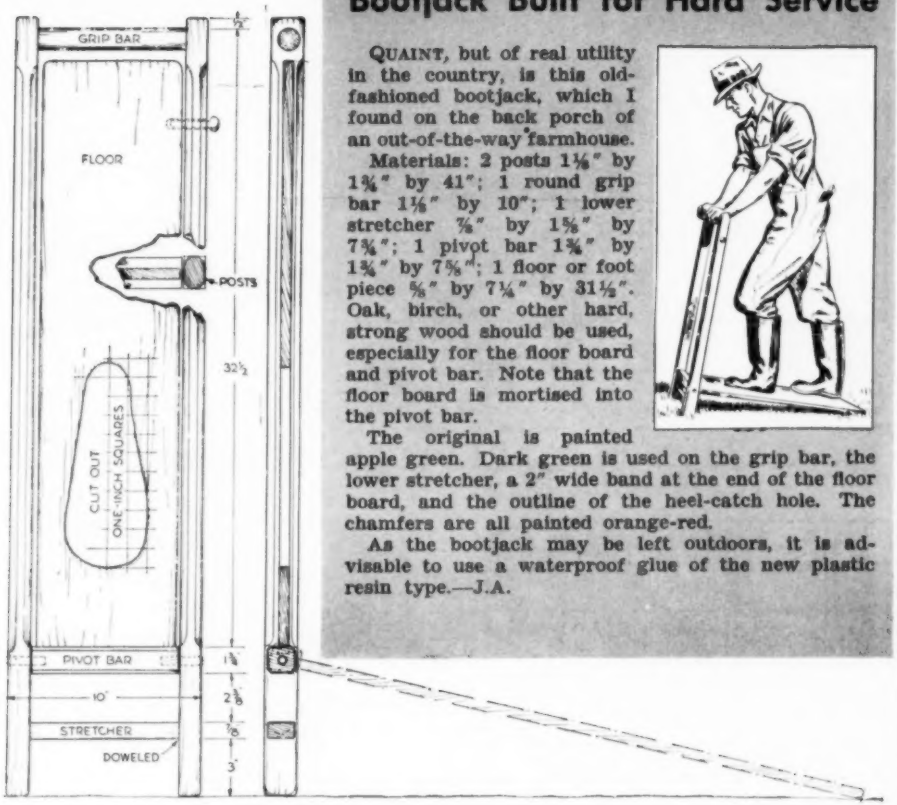
Bootjack Built for Hard Service

QUAINT, but of real utility in the country, is this old-fashioned bootjack, which I found on the back porch of an out-of-the-way farmhouse.

Materials: 2 posts 1⅛" by 1¾" by 41"; 1 round grip bar 1⅛" by 10"; 1 lower stretcher ⅞" by 1⅝" by 7¾"; 1 pivot bar 1¾" by 1¾" by 7⅝"; 1 floor or foot piece ⅝" by 7¼" by 31½". Oak, birch, or other hard, strong wood should be used, especially for the floor board and pivot bar. Note that the floor board is mortised into the pivot bar.

The original is painted apple green. Dark green is used on the grip bar, the lower stretcher, a 2" wide band at the end of the floor board, and the outline of the heel-catch hole. The chamfers are all painted orange-red.

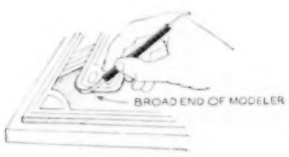
As the bootjack may be left outdoors, it is advisable to use a waterproof glue of the new plastic resin type.—J.A.

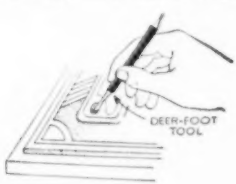


FLAT MODELING

[LEATHER CRAFT—5]

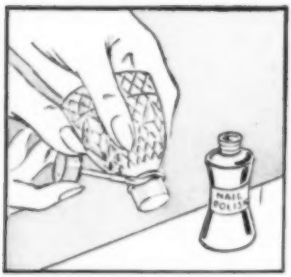
Flat modeling produces designs that appear to stand out above the surface of the leather. Prepare pattern and design, and cut leather (see Leather Craft—2 and 3). Transfer design to leather. Tool lightly (Leather Craft—4). Place flesh side of leather on hard surface. Put down background of design by using broad end of modeling tool and holding this end parallel to the leather. Move modeler back and forth until background is depressed below level of design. Use deer-foot modeler to depress small areas, holding it as shown. Do not work against the grain because that will roughen the leather. After background is put down, go lightly around edges of design with small end of modeler to divide it distinctly from the background.



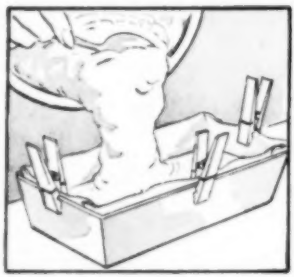


POPULAR SCIENCE MONTHLY SHOP DATA FILE

KEEPING THE HOME

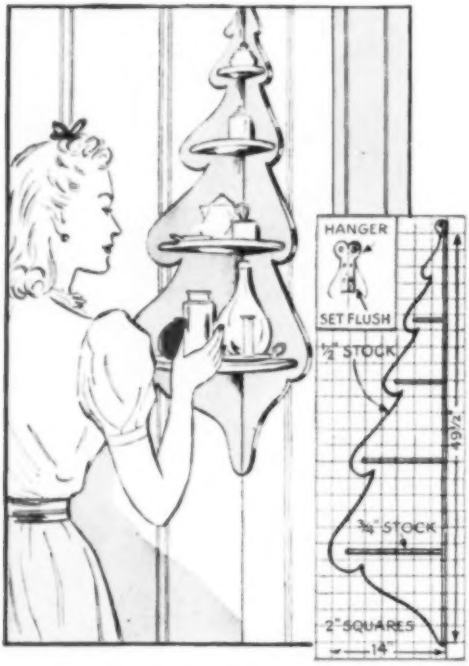


Perfume carried about in luggage often leaks out even though the cap was screwed on tightly. This costly annoyance can be prevented by sealing the cap joint with common nail polish. To open the bottle, cut seal with a nail file



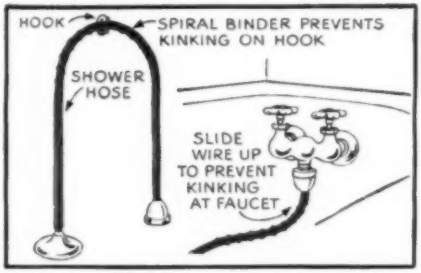
When batter is poured into pans lined with wax paper, the lining often slips and is folded under the dough. Four spring clothespins used as shown will hold the paper in position, thus leaving both the hands free for pouring

To keep a clean brush free of dust and protect the bristles from possible damage, slip it into a cardboard envelope such as pipe cleaners are packed in. Remove the brush by letting it slip out of the opposite end



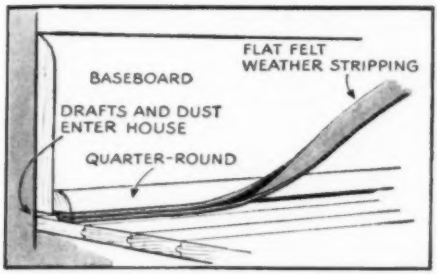
These corner shelves were patterned after an Early American pine-tree design, and are especially suitable for knotty pine interiors, vacation homes, and the like. Fit the sides together with a butt joint, and fasten the shelves in place with dowels or with countersunk screws. The piece may be suspended from a metal hanger set in flush with the back surfaces

A pair of long-nose pliers will facilitate fitting an atomizer bulb, small-diameter rubber tube, or similar parts. Use the pliers to stretch the opening in the rubber, as above



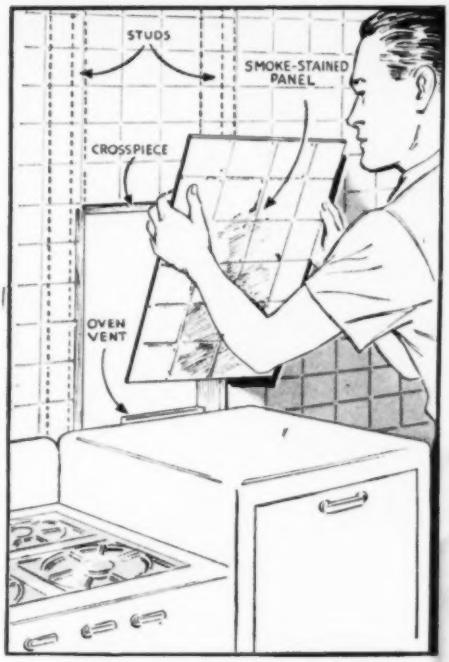
Kinking of a bath shower hose or other light rubber tubing can be prevented by slipping on it an ordinary spiral wire binder taken from a discarded notebook. Be sure to bend the ends into closed loops so that no sharp points remain to damage the hose. The position of the wire spiral may be changed in an instant to provide protection wherever most necessary

SHIPSHAPE

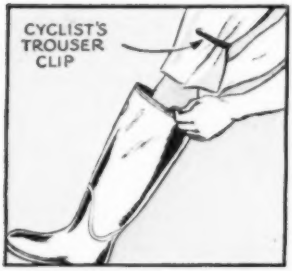


The crack under baseboard molding that has been raised at some time to accommodate heavy floor covering can be filled with felt weather stripping, folded and forced in as illustrated above

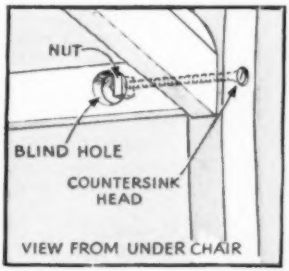
If your dog slips his collar persistently, try putting two collars on him, fastening the chain or leash to the one behind. It will be very difficult for him to strip this off over the other



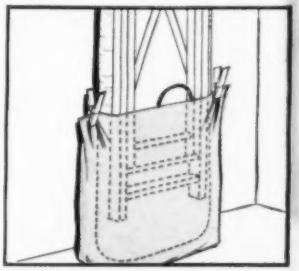
After some time, that part of a tile-board wall above the oven vent of a kitchen range may become so smoke stained that it cannot be cleaned satisfactorily. If a separate panel spanning two studs and crosspieces as shown is fitted here when the wall is being finished, and held in place with light finishing nails, it can be replaced readily



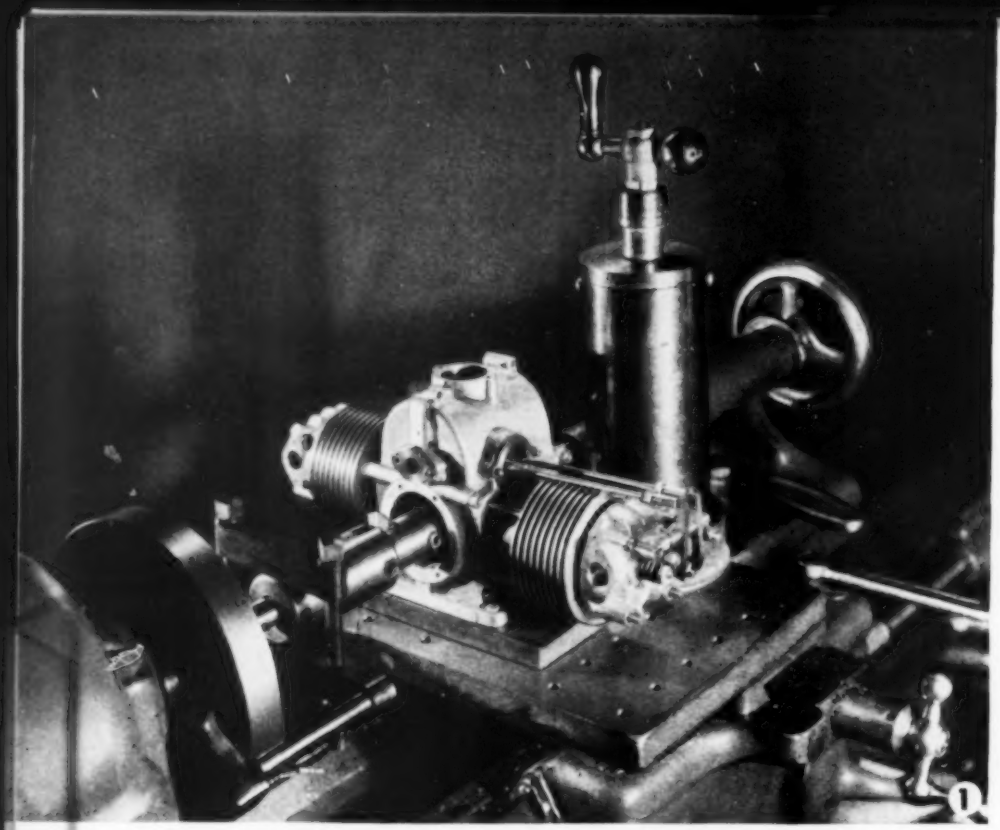
Either an ordinary cyclist's trouser clip, or a clock spring or strip of spring bronze bent to a similar shape, is convenient for keeping trouser cuffs folded over and tight against the leg when you are pulling on a pair of high rubber boots



Wobbly chairs can be reënforced without taking them apart by the method shown. Using a ratchet brace, drill a blind hole into the rail to receive a square nut. Countersink the head of the long screw through the leg, and fill the depression. Stain to match



Ironing boards that stand upon one padded end when folded are likely to transfer dirt from the floor to clothing. To keep such a board clean, stand it up inside an ordinary paper shopping bag, and clip the bag shut at the top by means of spring clothespins



Boring and Milling Table

ADDS TO UTILITY OF YOUR LATHE

By C. W. WOODSON

THE SCOPE of work that a small lathe can handle may be greatly increased by the use of the slide-rest attachment shown in Fig. 1, where it is being employed in boring holes for the crankshaft bearing caps in a model engine. Here a boring bar is held between centers, the work being moved against the cutter by the automatic longitudal feed of the lathe. Many such boring jobs that would be hard or impossible to chuck in the ordinary way can be done with this attachment, as can also light milling operations, keyway cutting, squaring the ends of shafts, and similar work.

All the machining necessary in making this useful attachment, with the exception of that on the table itself, was done in the lathe for which it was intended. The table is a simple iron casting made from a wood pattern, but since it measured 7¼" by 5½" and the supporting column sleeve was at one side, it was too large to be handled and therefore was sent out for machining. This work consisted of surfacing

the top and boring the hole for the sleeve. If the table is made smaller than this, it can probably be turned and bored on the faceplate of the lathe itself, but the larger size will be more useful.

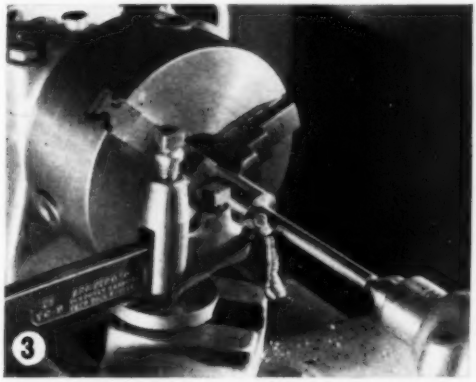
After the machining had been done, the holes for clamping work to the table were drilled as in Fig. 2, and tapped ¼"-20. They may be laid out to suit individual requirements, or the table can be left blank and holes drilled as necessary to suit the job in hand.

Turning the clamping screw from solid steel (Fig. 3) was a simple lathe job. The screw was threaded 5/16"-18, and the hole for it drilled in the table casting before the clamping slot was cut with a hack saw. One half of the hole was tapped to fit, the other half drilled out to clear the threads. This completed the work on the table, which is shown with the clamping screw in place in Fig. 4.

Cold-rolled steel was turned and bored to the dimensions shown for the base of the supporting column (Fig. 5). The bottom of this piece was made to fit the lathe, so that it can be clamped to the cross slide in place of the compound rest. Reversed in the lathe and supported by the steady rest, as in Fig. 6, the column was left-hand threaded for the adjusting screw, a specially ground cutter bit being used. The keyway was made with a Woodruff keyway cutter while the work was held in a milling attachment.

A brass tube of a size to be a nice sliding fit on the column was squared on both ends while held in the three-jaw chuck and supported by the steady rest, then drilled for screws to hold the key fast. The end cap was turned from steel to a snap fit in the sleeve, then reversed in the chuck as in Fig. 7 for threading the hole for the adjusting-screw guide. Drilling and tapping the holes for the two retaining screws, which was done with the end cap snapped into place in the sleeve, completed the supporting column.

The adjusting screw was made from ½" steel rod, centerdrilled at each end and turned between centers (Fig. 8). The left-hand Acme threads, 10 to the inch, were cut to fit those in the steel column. The work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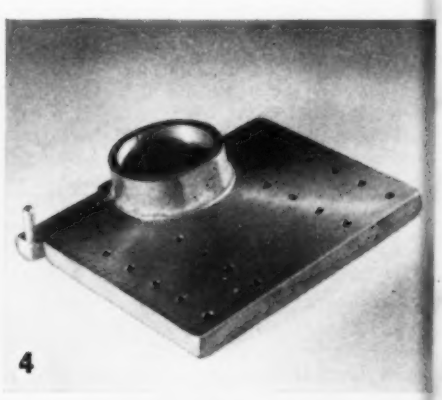
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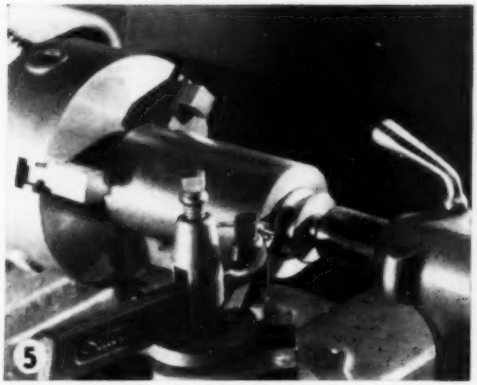
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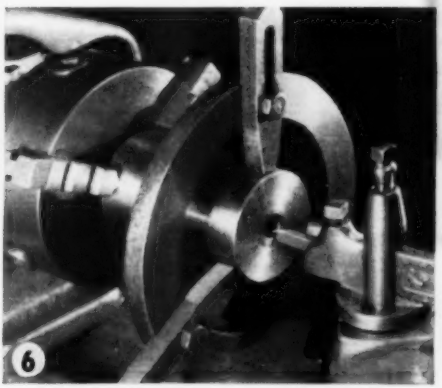
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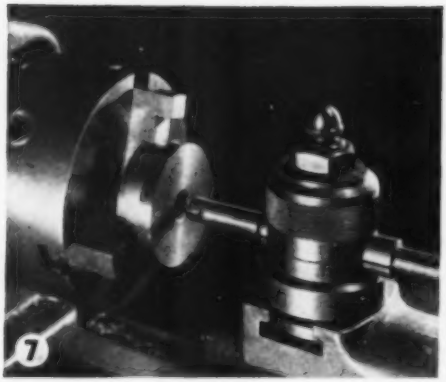
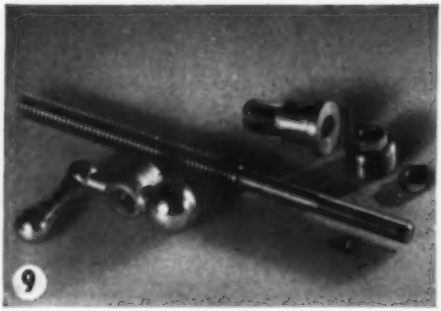
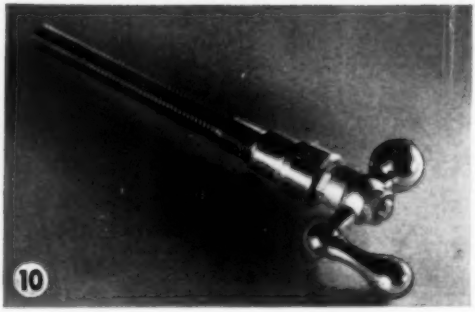
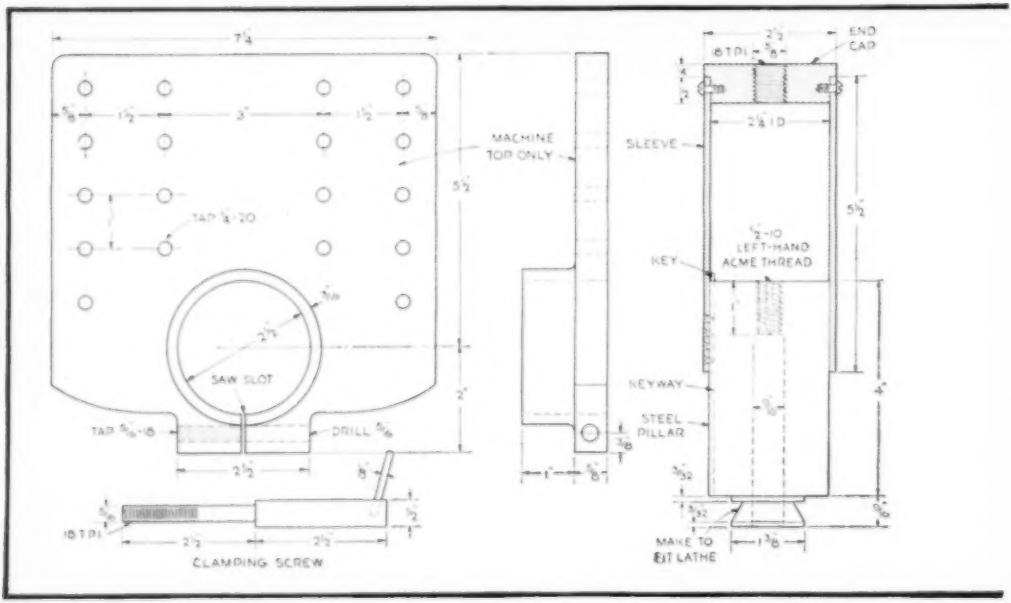
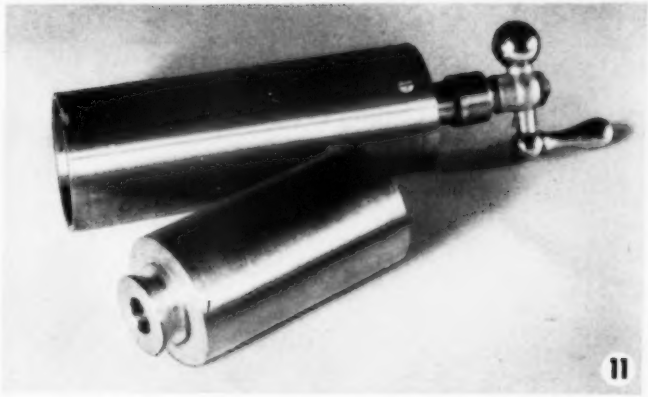






Threading the end cap, turning the adjusting screw, the complete set of parts for the screw, and the screw as it appears when assembled. Below, drawings of the table, the clamping screw, and the assembled column





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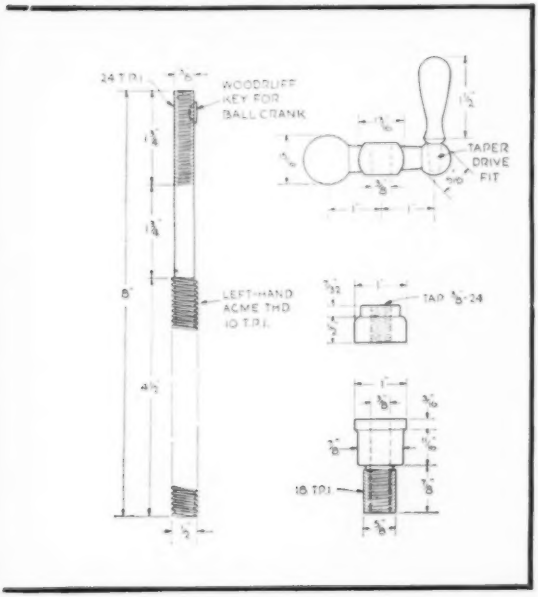
Left, the completed boring and milling table. Above, the base of the column and the sleeve unit with the adjusting screw in place

12

The drawings below give the dimensions to be used in machining the adjusting screw and its parts



was then reversed, and $\frac{3}{8}$"-24 threads were cut on the other end, after which the keyway for the ball-crank handle was cut in exactly the same manner as that in the column itself.

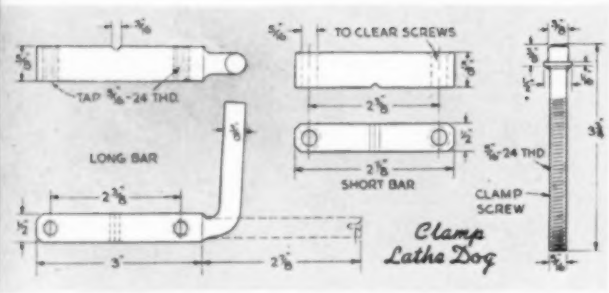
All the parts of the adjusting screw are shown in Fig. 9. Although the ball-crank handle can be made on the lathe according to the dimensions given, one from a discarded machine may be equally suitable. Figure 10 shows these parts assembled on the screw, and Fig. 11 the steel column and the sleeve. The finished accessory is illustrated in Fig. 12, ready for work.

Clogged Blowtorch Is Cleaned with Lacquer Thinner

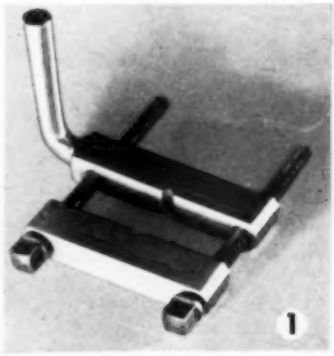
IF YOU have a gasoline blowtorch that is so badly plugged it will not work, try cleaning it with lacquer thinner. I have salvaged two ordinary torches by this method, and a garage owner, to whom I passed on the tip, was equally successful in cleaning a large blowtorch.

First, unscrew and remove the needle valve. Then, using a small camel's-hair brush, clean the deposit from inside and outside the burner with lacquer thinner. Replace the needle valve and put about half a teacupful of the lacquer thinner into the torch. Pump the torch full of air, open the valve, and allow the thinner to stream through the burner under high pressure. Do not light the liquid. After the torch is empty, remove the bottom plug so that any remaining liquid may evaporate. The torch may then be filled with gasoline and restored to service.—DICK HUTCHINSON.

MACHINISTS



Working drawings of the parts and, at right, the assembled lathe dog. Below are shown four of the more important steps



Steps in Constructing a Lathe Dog of the Clamp Type

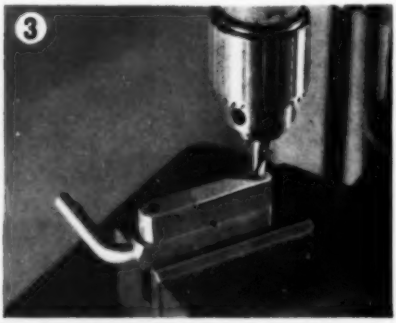
For those who are studying machine-shop practice in order to do their share in the industrial mobilization of America, POPULAR SCIENCE *is presenting a series of elementary projects. Four appeared last month, two are given here, and more will follow.*

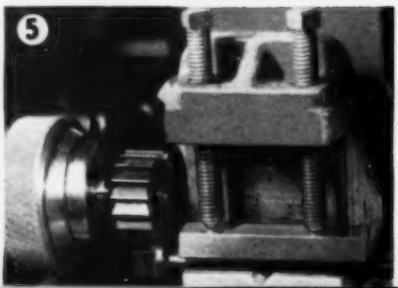
CLAMP lathe dogs of the type shown in Fig. 1 are simple to make and convenient to use. They are designed for a wide range of adjustments and will accommodate themselves to a variety of shapes—flat, square, oval, or round. For use on finished surfaces, they have the advantage of gripping the work without the mark that might be caused by the set screw of an ordinary lathe dog—often a matter of importance.

Steel of a reasonably good grade should be used for the crossbars. The lower one with the long tail is held in the four-jaw chuck as in Fig. 2, where it is first center-drilled for tailstock support and turned to $\frac{3}{8}$" in diameter for $2\frac{7}{8}$". The driving tail thus formed can then be gradually bent over with a heavy, soft-faced hammer while the bar is held firmly in a husky vise.

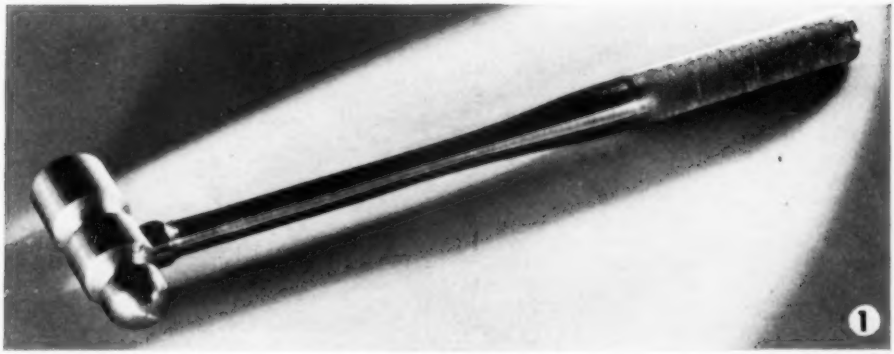
The short bar is sawed to length and the ends chamfered. Place the bars together and drill through both with a 0.272" drill as in Fig. 3. The holes in the short bar are then enlarged with a drill slightly larger than 5/16" to clear the screws, and countersunk on one side to fit the beveled base of the screw head. Figure 4 shows the 5/16"-24 threads being tapped in the long bar to receive the clamping screws. A V-shaped notch is filed in the center of each bar as an aid in centering whatever work is to be held by the dog.

For the screws, use $\frac{1}{2}$" tool steel, which is center-drilled, turned to size, and threaded in the lathe. The heads are squared to fit the tool-post wrench while held in the milling attachment as shown in Fig. 5.





FOR DEFENSE



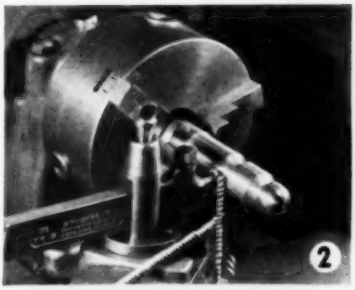
Machinist's Hammer Gives Practice in Simple Lathe Work

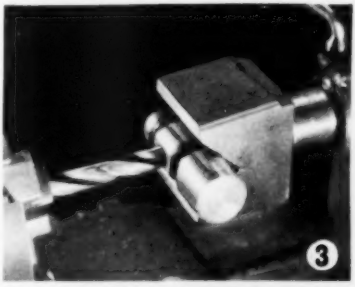
TURNING, drilling, knurling, and thread cutting are the operations involved in making this machinist's hammer (Fig. 1).

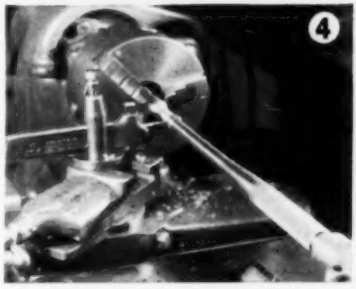
The head is best made from tool steel, which can be hardened when finished, and the temper drawn. It is turned from a solid bar to the dimensions in the drawings while chucked as in Fig. 2, then filed smooth, polished bright with emery cloth, and cut off. Reverse it in the chuck, and take a finishing cut across the face. The end is slightly chamfered. For drilling the hole, support the head in a crotch center (Fig. 3). Tap it 7/16"-24 in order to receive the handle.

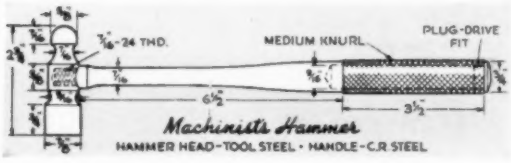
A length of ¾" mild steel may be used for the handle. Held in a three-jaw chuck as in Fig. 4, it is drilled to a depth of 4" with a 9/16" drill. This lightens the large end and improves the balance. A handgrip is knurled on the end of the handle for 3½", and the remainder of the handle is turned to the dimensions in the drawings. It is then filed smooth with a fine file and polished with emery cloth. Threads are cut on the end to fit into the tapped hole in the head. This is the operation illustrated in Fig. 4. Leave the threads slightly large so considerable force is needed to screw the two parts together. They can also be pinned with a small taper pin.

The hole in the handle should be closed with a small plug. Turn the plug to a slight taper for a drive fit. When it has been firmly driven in place, the hammer is ready for use.—C. W. WOODSON.









Damaged Ball-Bearing Race Replaced by Copper Strip

IN CONSTRUCTING machines and various mechanical devices for the shop or farm, it is sometimes necessary to use second-hand ball bearings in which the race that supports and separates the balls has been damaged, although the other parts of the bearing are still in good condition. If the bearing is of the type shown in the photo at the right, a repair can be made simply by weaving a copper strip or wire of suitable size in and out through the balls. Heavy copper may be handled easily if it is first heated red and plunged into water to anneal it. The strip in this instance was taken from the field coils of a discarded automobile starting motor.—R. A. CARRIER, JR.

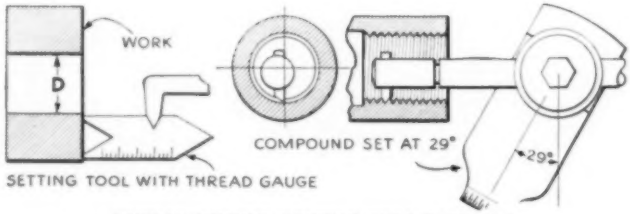
Satin Finish on Soft Metals Obtained with Suède Brush

VIGOROUS application of a wire suède brush will give a pleasing satin finish to soft metals, such as copper, aluminum, or silver. Be sure to brush in all directions, and take care not to touch the polished surface with the bare hands, for even small traces of perspiration may cause unsightly stains. Each wire acts as a tiny burnisher, and the resultant finish is often more effective than a high polish. After polishing, apply a coat of clear lacquer.—K. R. SIPPLE.

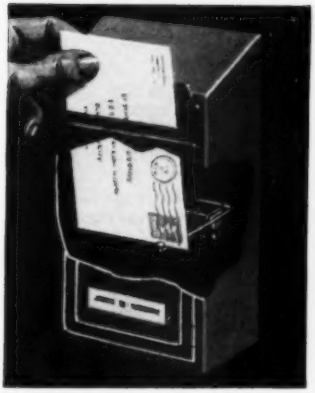
INTERNAL THREAD CUTTING [*LATHE WORK—22*]

In order to set the tool for internal thread cutting, a thread gauge is placed against the cutting edge of the tool bit, and the carriage is brought forward so that the thread gauge rests squarely against the work. The cutting edge of the tool is then adjusted to the center line of the work.

SETTING THE TOOL FOR INTERNAL THREAD CUTTING



POPULAR SCIENCE MONTHLY SHOP DATA FILE



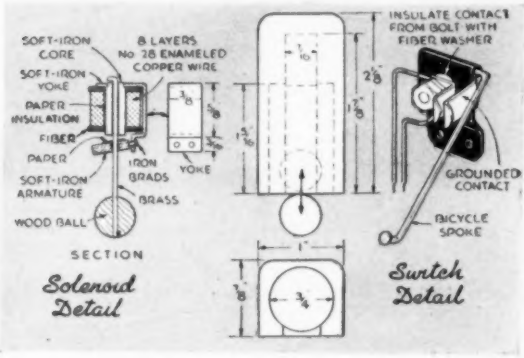
Connect switch in series with the winding. After removing mail, reset switch and push ball into case

Automatic Electric Indicator Drops As Mail Is Deposited in Box

THERE'S no need to wonder whether the letter carrier has left anything in the mail box if you install this neat little indicator in the kitchen or any other convenient place. The little black ball drops into view when mail is delivered.

A ¼" hollow soft-iron rivet can be used for the magnet core, or the latter can be turned from iron rod and drilled lengthwise for the brass shaft. Turn a shoulder at one end and rivet it over the yoke. Bring the winding leads out through holes in the lower fiber washer. The armature is pinned loosely to the yoke with iron brads. Make the case of hardwood.

In the letter box install a switch, either of the type shown or a small homemade mercury switch, to close the circuit *momentarily* when mail is inserted. Dry cells or a bell transformer will supply the current.—W. P. S.



The edges of an oversize hole in the armature wedge the brass rod up until armature is attracted by the core. Ball then drops instantly. Wrap paper about magnet and insert it as shown in the photo

ELECTROPLATING, PART 6 [ELECTRICAL]

Preparation of the work is of primary importance because the finish of the plated metal will be no smoother than the surface is to begin with. No amount of plating will make a rough surface smooth.

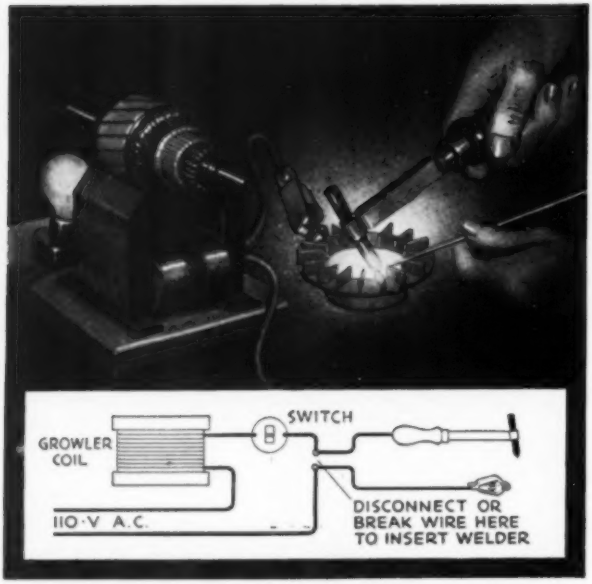
Various types of grinding and polishing wheels are available, and they may be used on the spindles of a polishing head, on a lathe, or on a spindle attached directly to the shaft of an electric motor. For very small work, suitable wheels may be obtained for any of the popular hand-held power tools. Various abrasives are used, and these are most convenient if obtained in the form of sticks or cakes.

Very rough surfaces must first be ground down with coarse abrasive, generally emery used with a muslin or other suitable wheel operated at a speed of from 1,250 to 1,750 r.p.m. Finer emery or a suitable composition will then reduce the coarse scratches to much finer ones, until the work appears quite smooth. It is then "colored" or given a high polish with a soft cotton wheel and tripoli, or one of the special coloring compositions; or with rouge in the case of silver, gold, and some of the soft metals. Wheels for this final polish may be operated much faster, at from 3,000 to 4,000 r.p.m.

Wheels are mounted so that the upper half turns towards the operator. Sticks and cakes of grinding and polishing composition are applied by holding them against the edge of the revolving wheel. The work is placed against the wheel considerably below center and then brought upwards. Particularly in the case of a fast wheel, the work must be grasped firmly to avoid having it thrown from the hands.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Shop Growler Used to Limit Current for Arc Welding Torch



An armature-testing growler limits current for light welding. The larger the armature placed across the gap, the less current flows

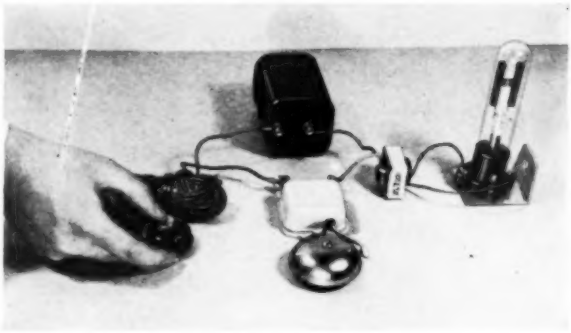
A SMALL battery-type carbon torch for soldering and light welding can be used successfully on 110-volt alternating-current lines if some sort of choke coil is incorporated in the circuit. An armature growler will serve the purpose. It is connected in series with the torch as shown in the diagram.

For soldering and light brazing, where only a moderate heat is required, place an armature across the gap. This increases the reactance of the coil and reduces the current still further. If more heat is required, as for brazing or light welding, remove the armature. Satisfactory current regulation is obtained by using large or small armatures, or pieces of iron or steel of various sizes, across the core gap, as required.—W. C. W.

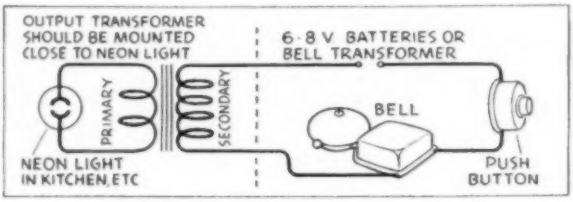
Glowing Neon Lamp Gives Visual Signal When Doorbell Rings

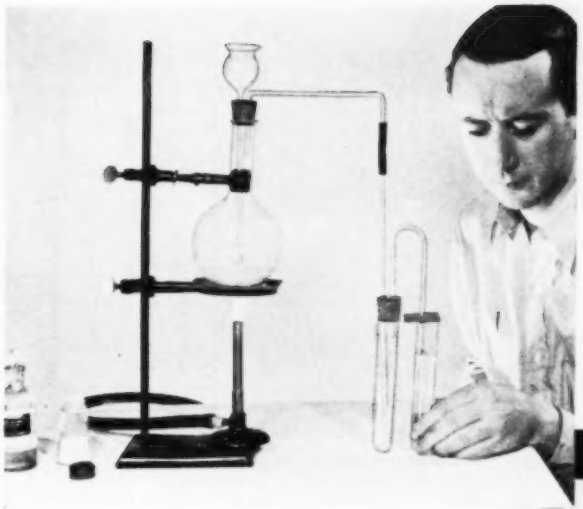
FOR a person whose hearing is impaired or for those who work in noisy shops, a visual call signal can easily be added to any ordinary doorbell or buzzer circuit.

A 110-volt neon lamp and a common radio output transformer with a 6- or 8-ohm (low number of turns) secondary are used. The lamp and transformer are placed in the bell circuit as shown. Note that the lamp is connected across the primary winding of the transformer, which should be mounted close to it. The bell acts as a vibrator, creating a surge voltage across the primary winding of the transformer that is much higher than 6 volts—in fact, sufficiently high to light up the neon lamp. Either dry cells or a doorbell transformer may be used as the source of the current.—A. C. MILLER.



When the doorbell circuit is closed, a current induced in the primary winding of the radio transformer causes the neon lamp to glow





Generating hydrogen chloride gas by gently heating a mixture of salt and sulphuric acid. Bubbling through water in the test tube, the gas produces hydrochloric acid. What remains of the salt is crude sodium sulphate, or "salt cake"

In addition to making other sodium compounds from common salt, you can reverse the process and make sodium chloride from washing soda (sodium carbonate). Saturate the soda with hydrochloric acid and then allow the acid to evaporate

HOME TESTS WITH COMMON SALT INTRODUCE VALUABLE SODIUM FAMILY

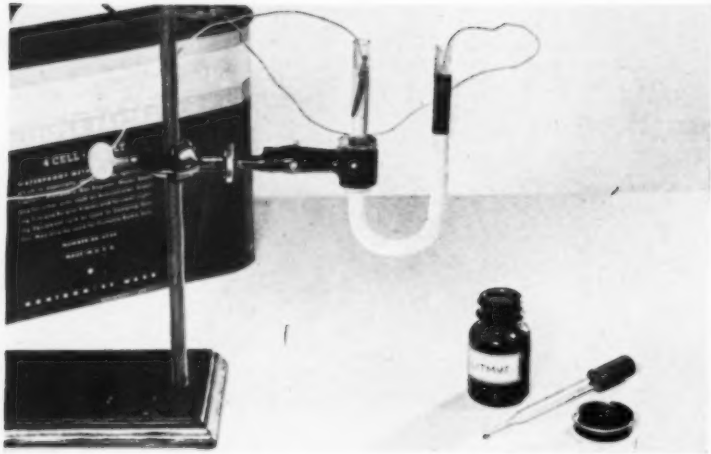
DID you know that by passing a current of electricity through a saturated solution of common table salt in water, you could change this vital food element into deadly biting lye; that by heating it with sulphuric acid, and leading the acrid gas evolved through water, you could make your own hydrochloric acid; and that by other chemical manipulations, mostly simple, you could transform salt into washing soda, baking soda, borax, Glauber's salt, and a long list of other valuable sodium compounds?

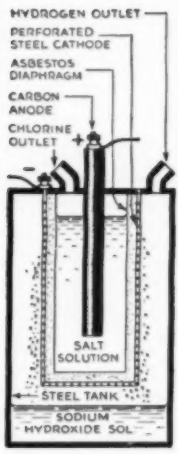
This is one of the fascinating features of chemistry—that compounds within a single chemical family, no matter how different in individual appearance and reaction, are intimately related, and that with the right magic touch from the chemist they may be changed endlessly from one to the other and back again.

In the case of salt and sodium compounds, the possibility of transformation is fortunate. Salt, or sodium chloride, is one of the most abundant compounds in nature. Beds of rock salt are frequent. In the seas of the earth, alone, experts estimate that there are 36 million billion tons of salt. Salt is obtained from this source by running sea water into shallow basins and allowing it to evaporate.

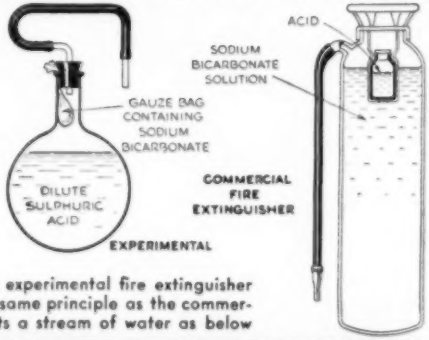
Besides being an important mineral food, a preservative for meat and fish, and an element in freezing mixtures, common salt is the starting point for the manufacture of practically all sodium and chlorine compounds used today. Many of these manufacturing processes may be duplicated easily, on a small scale, in the home laboratory.

With only a glass U tube and a battery of several dry cells, for instance, you can demonstrate how a strong salt solution may be changed to a solution of sodium hydrox-





Experimental set-up for extracting chlorine, hydrogen, and sodium hydroxide (lye) from brine. Drawing shows the Nelson cell used commercially



ide, known popularly as caustic soda or lye. Set up the tube as shown in the photograph, connecting the battery terminals to the brine through electrodes made of several magazine-pencil "leads" bound together. If you now place a few drops of red litmus solution in each branch of the tube, you can trace more readily what happens.

As soon as the battery wires are connected, the solution about the anode, or electrode connected to the positive pole of the battery, will begin to turn blue. This indicates the formation of sodium hydroxide, which is a strong alkali. At the same time, the solution about the other electrode, or cathode, will bleach out, owing to the formation of chlorine gas at that pole. Continued application of the current will finally change the salt completely to hydroxide.

Commercial production of this chemical is carried out by means of a Vorce or Nelson cell, an apparatus illustrated by the diagram. In this cell, the sodium hydroxide, the chlorine, and the hydrogen which is liberated at the anode, are kept separate to prevent complicated reactions. The gases are also collected for other industrial uses.

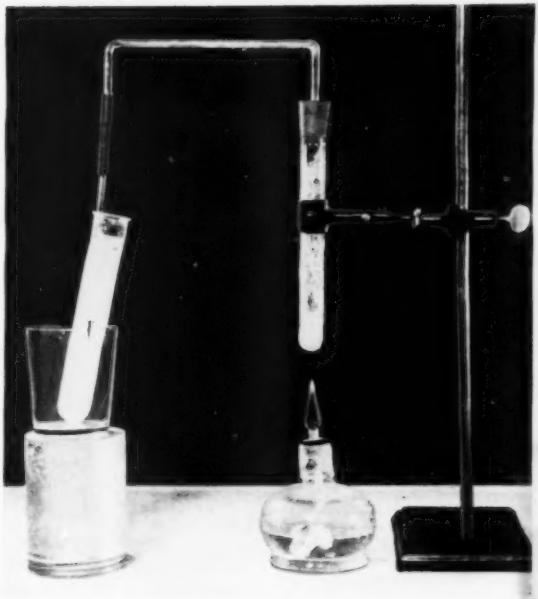
In many chemical changes, this is true: by-products are formed which are often as valuable as the chief chemical desired. When we mix salt with sulphuric acid, for example, and gently heat the

You can make an experimental fire extinguisher that works on the same principle as the commercial type. It squirts a stream of water as below

mixture, the gas hydrogen chloride is given off. Bubble this gas through plain water and we produce hydrochloric acid. What remains of the salt, after all the gas has been given up, and the remaining sulphuric acid evaporated, is no longer plain salt, but sodium sulphate. In its crude form this chemical is known as "salt cake," and when recrystallized and refined, as Glauber's salt, a cathartic.

The set-up for generating hydrogen chloride gas, making hydrochloric acid, and leaving sodium sulphate as a by-product, is clearly shown. Put the salt in the flask, and drop the sulphuric acid slowly through the thistle tube. To prevent too vigorous a reaction, use a very mild heat.

Next to salt itself, sodium carbonate is one of the most valuable sodium compounds. It is used in making glass, soap, and soap powders, and in refining petroleum; for softening water, cleaning and dyeing, and as a basis for other sodium compounds. It is found to only a limited extent in nature, but is manufactured in enormous quantities by a process invented by a Belgian chemist, Solvay.



Sodium bicarbonate (baking soda) is changed into sodium carbonate by heating it. That the gas driven off is carbon dioxide is proved by its turning limewater cloudy

One of the world's greatest chemical processes, the Solvay process is an amazing instance of complex chemical transformation in which nearly a dozen by-products are completely utilized. Its essence is this: carbon dioxide under pressure is forced through a saturated water solution of salt and ammonia gas. A number of complex reactions take place, producing finally a nearly insoluble sodium bicarbonate in a solution of ammonium chloride. The bicarbonate is separated from the solution by filtering, purified by washing, and changed to carbonate by heating.

The outstanding characteristic of sodium bicarbonate, known commonly as "baking soda," is its ability to liberate carbon dioxide when mixed with acid substances. Mixed with sour milk, or with powdered acids in baking powder, it generates gas that "raises" cake and bread dough. Mixed with sulphuric acid, it produces the pressure in chemical fire extinguishers.

In commercial fire extinguishers, a tank nearly filled with sodium bicarbonate solution has at its top a bottle of sulphuric acid. The bottle is so arranged that it will spill its contents, mixing them with the bicarbonate, when the tank is inverted.

An experimental extinguisher may be made from a flask and several pieces of tubing, as shown. To simplify construction, the solution in this case is dilute sulphuric acid, while the bicarbonate is placed in a small bag suspended above the solution when the flask is upright. By inverting the flask the chemicals mix, gas is formed, and the solution is forced out in a powerful stream.

Bicarbonate of soda is changed into sodium carbonate merely by heating it. Put a little in a test tube having a bent glass tube leading from it into a second test tube containing limewater. Apply heat to the first tube and bubbles of gas will come up through the limewater. They turn it milky, proving that the gas is carbon dioxide. When the gas stops bubbling, your baking soda has been changed into "soda ash," a dry form of sodium carbonate. Dissolve this dry powder in water, let the water evaporate slowly, and you finally find large crystals of "washing soda," sodium carbonate incorporating water in its structure.

Maybe you would now like to start reversing things! Dissolve sodium carbonate in water, and bubble carbon dioxide through it, and you change it to bicarbonate. Dissolve sodium carbonate in hydrochloric acid, let the acid evaporate, and you are back where you started, with common salt!

Experiments Show Odd Facts About

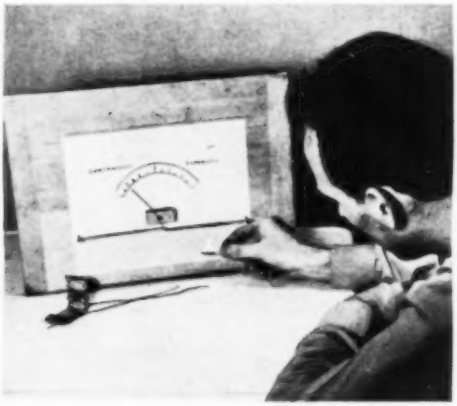
WATER CONDUCTS HEAT POORLY. You can prove it by boiling the top of some water in a test tube as illustrated above. The lower part of the tube scarcely gets warm. The use of hot water for house heating does not depend on heat conduction, but on convection or circulation

ANYONE who enjoys an iced drink in summer, or who hugs the radiator in winter, will be interested in the simple home experiments with heat and cold presented here. For variety, the editor of this department has also included a demonstration of atmospheric pressure, of the curious Bernouilli effect on objects in an air stream, and of a hydraulic press. It is hard to realize that only a few ounces of water can exert a force of hundreds of pounds, but seeing is believing.

The experiment in which the pressure of the atmosphere supports a tumblerful of water is all the prettier because it is so easy to perform. In fact, countless waitresses have been left baffled as to how to pick up the upside-down glassful, which some prankster has left upon a restaurant table after deftly slipping out the card. Putting back a card without spilling water is all but impossible. The clever waitress slides the glass off the table edge above a basin, to catch the water; but even this becomes difficult if the table has a raised edge rather than a flat one. Needless to say, POPULAR SCIENCE MONTHLY cannot properly lend its official approval to such a trick, which, however, probably antedates the founding (1872) of this magazine.

MAGIC WITH A TUMBLER. Fill a glass with water and set a flat piece of cardboard on its mouth. Carefully invert the tumbler, and you can withdraw the hand supporting the card. The water will stay in the tumbler, held by 14.7 pounds of atmospheric pressure per square inch of card

EXPANSION OF METALS when heated can be measured with the homemade instrument below. A wire to be tested is attached and adjusted so the pointer registers zero. You can also prove that rubber contracts when heated, by using two bands pulling against each other as illustrated



Heat and Cold

ICE MELTS AND WATER FREEZES at the same temperature. Place a glass of partly melted ice in a pan of warm water and stir with a thermometer. Temperature stays at 32° until all ice melts. Place the glass of water in a bowl of ice and salt, and it stays at 32° until all is frozen

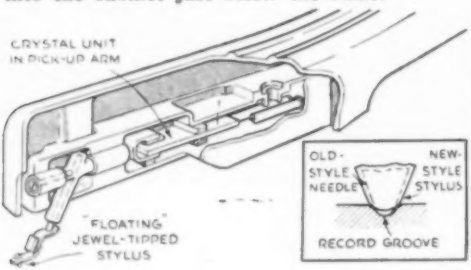
MODEL HYDRAULIC PRESS. Fasten a toy balloon to a glass tube two feet high. Merely by adding water to the tube, you can lift surprising weights placed on the balloon as seen above. The same principle is used in hydraulic presses, hydraulic elevators, hydraulic brakes

VELOCITY OF AIR REDUCES ITS PRESSURE. Attach two strips of paper to the end of a glass tube. Try as hard as you will, you can't blow them apart. Air passing at high speed between them acts like a partial vacuum, and the air on their outer sides pushes them tightly together

SENSITIVE THERMOMETER. Merely waving your hand between the desk lamp and this sensitive thermometer makes it respond. From a one-hole cork in the candle-flame-blackened flask, glass tubing dips into a beaker of colored water. Have the tube half full of water for the test

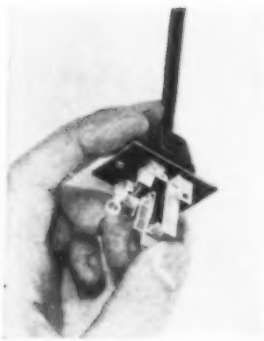
Radio Ideas

BETTER REPRODUCTION of phonograph recordings, with a minimum of needle scratch and surface noise, is claimed for a new radio-phonograph combination which has a "floating" jewel-tipped stylus that rides on the sides of the recording grooves instead of on the bottom. It also has a new crystal pick-up. The phonograph slides into the cabinet just below the radio.



TESTING "A" AND "B" BATTERIES in a portable radio is simplified by a new meter which has flexible terminals fitting any type of wire socket. Colored sections on the dial aid accurate reading.

KNOB PULLER. This cadmium-plated, spring-steel device is used for removing "push-on" control knobs without breaking or marring them. Its jaws slip behind the knob to provide a good grip without touching the outside.



PLUG SWITCHES of the type at the left are used to control the circuits in three-way portables. A standard line plug in the switch socket cuts out the batteries and switches in the rectifier.

MIDGET RECTIFIER. Only 1⅞ inches high, a new heater-cathode type of rectifier tube should prove useful to amateurs interested in making extremely compact sets. It was originally designed for use in three-way portables.

The public-address amplifier in use. With the radio-frequency tuner, it will rival in performance many larger sets

TUNER AND AMPLIFIER MAKE WORLD'S SMALLEST

Public-Address Units

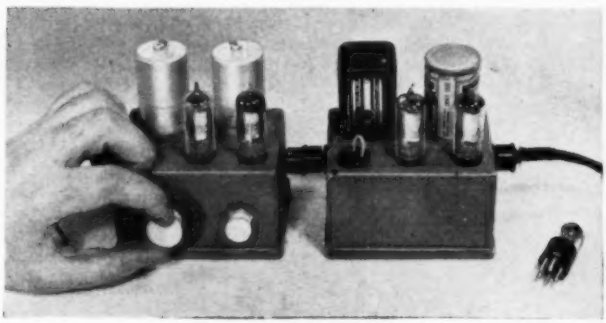
SMALL enough to fit into the palm of one's hand, these midget public-address amplifier and radio-frequency units will perform as well as many larger battery or A.C.-D.C. sets. Only 3⅞" long, 2⅞" wide and 2⅜" high, they are completely self-contained, even to batteries.

In the tuner there is a 1½-volt "C" battery, used as a bias for the 1T4 detector tube, and two flashlight batteries (in parallel), supplying 1½-volt "A" current to the two 1T4 tubes. Inside the amplifier is a 67½-volt "B" battery which supplies plate current to all the tubes in both units, and a large-size flashlight cell for lighting the filaments of the three amplifier tubes (HY123—1Q4—1Q4).

The tuner consists of a radio-frequency stage using a pentode r.f. amplifier coupled to a detector stage using the same type of tube. Coupling is accomplished with an iron-core r.f. coil with a shielding can of 1⅛" diameter. The antenna coil, of the same size, also has an iron core.

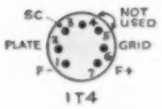
The amplifier unit consists of a triode

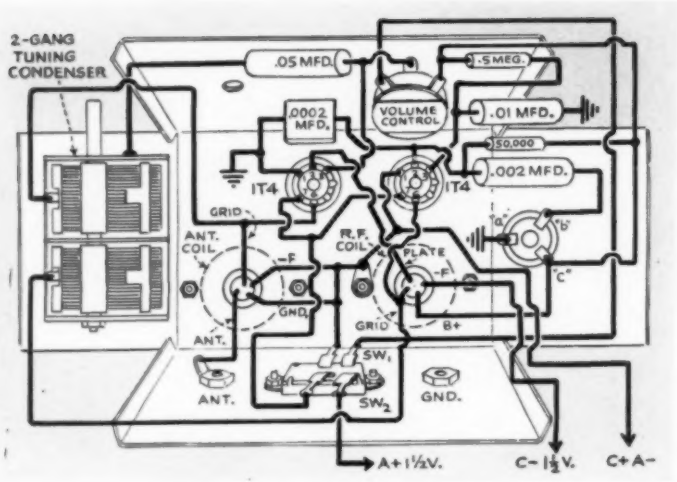
At the left is the tuner unit. It may be used individually as a headphone receiver or with the amplifier as a broadcast set

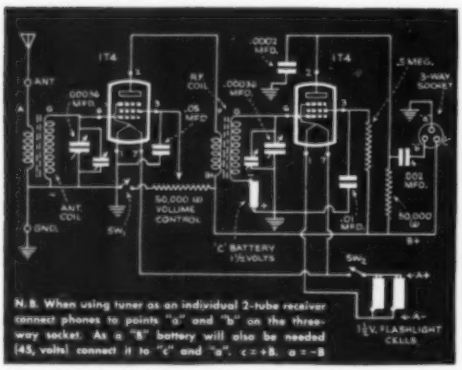


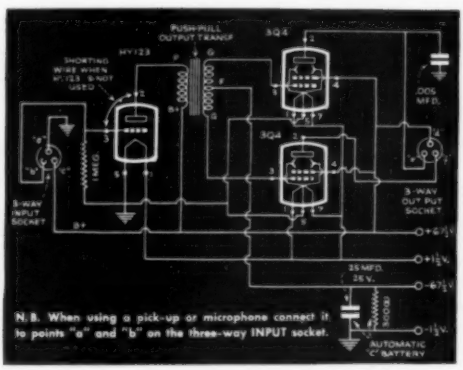
When the amplifier is connected with the tuner, the triode tube is removed and the grid and plate terminals of the socket are joined by a piece of insulated wire

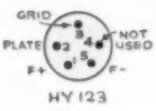
The tuner is a radio-frequency stage using a pentode r.f. amplifier coupled to a detector stage using a tube of the same type. Coupling is accomplished by means of an iron-core r.f. coil



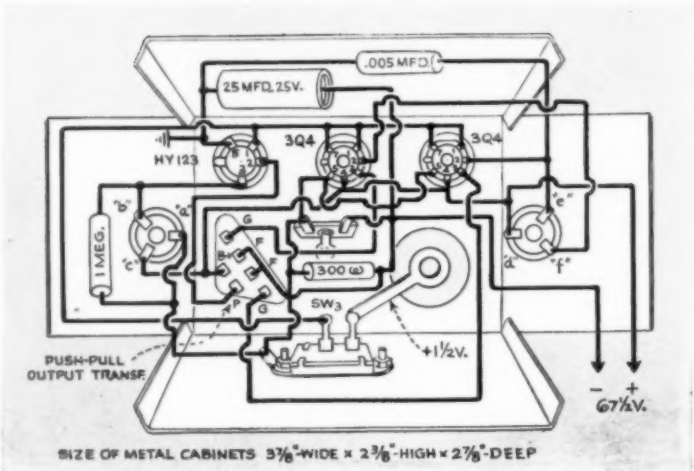


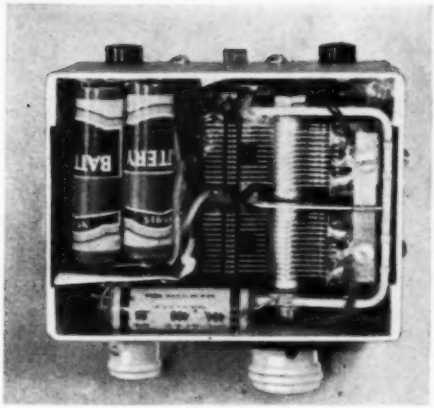




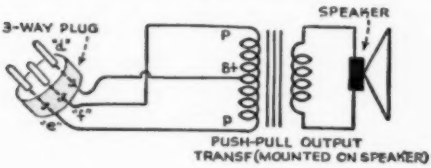


The amplifier unit consists of a triode input stage, transformer-coupled to a pentode push-pull output stage. Small three-prong plugs are used to connect the units together





This is the underside of the tuner cabinet, showing the midget two-gang condenser and the batteries

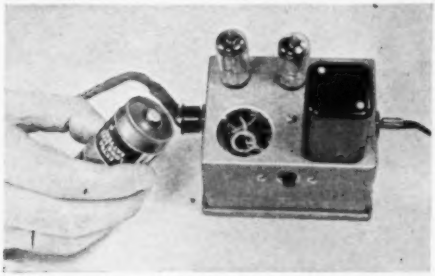


input stage transformer-coupled to a pentode push-pull output stage. When the amplifier is connected to the tuner, remove the triode tube (HY123) and join the grid and plate terminals of the socket as shown.

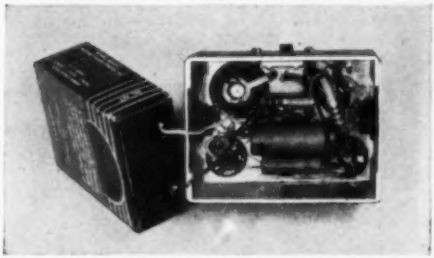
Small three-prong plugs are used to connect the units, and a similar plug joins the output transformer to the speaker, which may be any type of p. m. speaker.

The tuner may be used individually as a sensitive headphone receiver, or it may be connected to the amplifier to form a powerful broadcast set. Either a combination of antenna and ground, or just a short antenna, may be used with the tuner.—ARTHUR C. MILLER.

Since the amplifier "A" battery lasts only eight to ten hours, its replacement is simplified by mounting it above the chassis as pictured below



Positive contact of the "A" battery is made to a lug soldered to one of the lugs on the switch. The minus connection is made by contact with cabinet



The 67½-volt "B" battery that supplies plate current to all the tubes in the two units fits snugly in the bottom of the gray wrinkle amplifier cabinet

PARTS FOR TUNER

Iron-core antenna and r.f. coils (shielded).
Volume control, 50,000 ohms.
Miniature 7-prong tube sockets (2).
Midget two-gang tuning condenser.
Miniature r.f. pentode tubes (2) 1T4.
Miniature slide switch d.p.s.t.
Three-way miniature plug and socket.
Insulated banana plug and jack.
Small 1½-volt flashlight cells (3).
Tubular condenser, .05 mfd., 200 volts.
Tubular condenser, .01 mfd., 200 volts.
Mica condenser, .0002 mfd.
Carbon resistors, ½ watt, .5 megohm; ½ watt, 50,000 ohms.
Tubular condenser, .002 mfd., 200 volts.

PARTS FOR AMPLIFIER

Midget push-pull audio transformer (1.15:1).
Miniature 5-prong tube socket.
Miniature 7-prong tube sockets (2).
Miniature s.p.s.t. slide switch.
Three-way miniature plugs and sockets.
Standard p.m. speaker with transformer.
Miniature dectector tube, HY123.
Miniature beam-power pentodes, 3Q4.
Flashlight battery, 1.5 volts.
Miniature 67½-volt "B" battery.
Electrolytic condenser, 25 mfd., 25 volts.
Carbon resistor, 1 watt, 300 ohms.
Carbon resistor, ½ watt, 1 megohm.
Tubular condenser, .005 mfd., 200 volts.

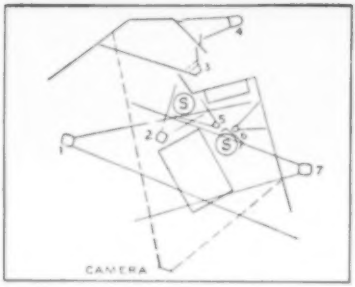


Fig. 1. Candlelight scene with a weak daylight effect outside the window. The lighting required seven lamps arranged as in diagram at left. Subjects are marked "S"

Dramatic Lighting for Indoor Movies

By ARTHUR MILLER, A.S.C.

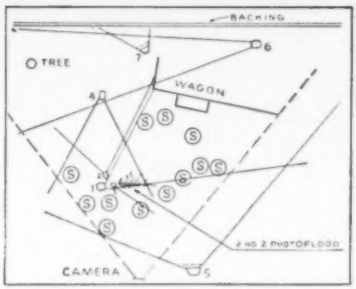
When a director at the Twentieth Century-Fox Studios wants very dramatic lighting, he asks that Arthur Miller be assigned to photograph the picture. Two outstanding examples of Mr. Miller's recent work are "Man Hunt" and "How Green Was My Valley." Lighting a scene, indoors or out, is comparatively simple, he asserts. In the accompanying article he explains how to do it with small, inexpensive, easily obtained lamps.

SO YOU'VE exhausted all the tricks of outdoor movie making! You have shot the children swimming, rowing, and hiking in sun-bathed summer scenes. You've opened up for the shadows, and done pretty well with those deep-in-the-woods camping sequences. And now you want to try your hand at a story requiring artificial lighting.

I can give you the solution in a sentence: Control your light, and don't let it leak and spill out into the shadows.

Happily, with the development of faster films, you do not require great floodlights. You can touch your celluloid canvas with delicate brushes of light

Fig. 2. Camp-fire scene taken indoors on a sound stage. Two No. 2 photofloods were set behind the "fire," and an oil-soaked wick was burned in a pan to give wisps of smoke



from small, inexpensive, low-power lamps.

To illustrate how small lamps may be used to create precision lighting, I have selected four stills from two recent pictures which I filmed. Alongside each photo, you'll see a diagram that shows in detail where the lights were placed—key lights, cross lights, filler lights. These drawings may seem complex, but don't let them frighten you. You need follow nothing but their general pattern, employing fewer units. Make sure only to attain the desired balance of lights and shadows.

The largest light ordinarily needed for amateur use is a so-called "dinky," or very small 150-watt spotlight. From this, you can taper down through the new 75-watt "peanut" tubes (projection lamps) to ordinary 50-watt unfrosted household lamps.

Now let's look at my examples. Since they are professional work, a few larger lamps have been used, but that does not alter the validity of what I have just said. The amateur generally would encompass smaller areas in his pictures and therefore need nothing larger than 150 watts.

The first example (Fig. 1) presents a candlelight scene. To strike the proper visual mood for fast action—menace and sword play—we combine the effect of candlelight with a trace of weak daylight outside the window.

The set-up is simple. A baby spotlight of the 500-watt type shines across the table into the face of the frightened man in the chair. A second baby spot similarly illuminates the masked bandit and white back wall, causing his shadow to stand out prominently. In the background, the alcove is

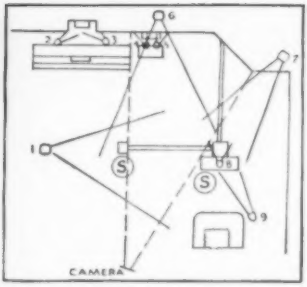


Fig. 3. A scene of dramatic intensity in which the lighting makes Tyrone Power, masquerading as a monk, darkly invisible to Linda Darnell. Three baby spots and six "dinkies" were used

illuminated by a third baby spot, covered with silk to diffuse the beam. A smaller spotlight (No. 4), also silked, projects the weak evening sun through the windows.

Note that the masked man leans against a tall candlestick. To create the illusion of his being lighted from that source, we place a dinky spot (No. 5) on the floor slightly closer to the camera than the candlestick, and concealed from the lens by the table and chair. Also concealed nearby, another dinky (No. 6), silked for diffusion, lightens the shadows in the corner beyond the players.

Don't be afraid to experiment. You'll find you can hide all sorts of lights behind tables and chairs, and even people, where they'll be effective. In Fig. 2, for example, we have an outdoor effect, although this actually was filmed indoors on a sound stage.

Here we have a different light source, the open fire. But flickering flames cannot produce strong foreground illumination and strong shadows. What do we do to overcome these difficulties? Simple. Place two No. 2 photofloods behind the fire, and burn an oil-soaked wick in a metal pan placed behind them to get the firelight effect. Baby spot No. 1 (500 watts) is set on the ground near the fire, directed toward the two men at the covered wagon. A dinky (No. 2) nearby lightens shadows toward the left. High-light the two men sitting near the center with dinky No. 3; rim-light the men at left and center foreground with a baby spot (No. 4) placed high on the left; and provide soft front lighting with a silked baby spot (No. 5) alongside the camera. Two other baby spots (Nos. 6 and 7), both silked, high-light the background and illuminate the backing in the distance.

The dramatic intensity of the scene shown in Fig. 3 is due almost entirely to the lighting. One face is completely obscured in a heavy shadow. Why? To make Tyrone Power, masquerading as a monk, darkly invisible to Linda Darnell; to present her beauty attractively; and to give the set pleasing composition while keeping the lighting of the subjects logical.

A glance at the diagram shows nine light sources—three 500-watt baby spots and six 150-watt dinkies. A baby spotlight (No. 1) furnishes the key light, bathing the actress' face strongly and hiding Power's features in deep shadow. Baby spot No. 7, placed high and beyond, separates Miss Darnell from the background by back-lighting both the rail and the actress. Baby spot No. 6 gives additional top back light.

Now we come to the lighting which provides the effects that *make* the scene. Dinkies Nos. 2 and 3 are hidden behind flowers on the altar, and cast their beams upward along the wall. Notice that the rays strike in front of the unlighted candlesticks, casting their shadows against the wall. But note that dinkies Nos. 4 and 5, concealed behind flowers on the smaller altar at right, flood the wall behind the candlesticks. Again, this method is logical because these candles are lighted, and the lights produce a visual effect of illumination from the candles.

Two other dinkies, Nos. 8 and 9, illuminate a wall figure behind the actress and provide soft filler light in the right corner of the room.

Suppose, instead of modern lamps or candles, you plan a scene calling for an old-fashioned oil lamp to be suspended over a kitchen table. Mother and sister are your characters. Transpose Fig. 4, eliminate seven of the players, and you have it.

Main lighting comes from the oil lamp, but a No. 2 photoflood bulb inside the lamp shade provides the light, reënforced by a dinky directed downward from the ceiling. Key lighting on the three men behind the table at left comes from a dinky (No. 2) concealed on the table by a character sitting in the foreground. The strong light striking the face under the window at the right comes from another dinky (No. 3) hidden by the man standing in the foreground. The character at the extreme right is illuminated by dinky No. 4. Three others illuminate the backing seen through both windows, and provide the faint light entering the windows.

Professional cinematographers long have hoped for a combination of fast film emulsions and small lights that would enable pictures to be taken under natural levels of illumination. Not only has that day arrived, but it is a comparatively simple matter for you to translate the set-ups I have described for use in your own home. Keep in mind the importance of using small, hidden lights for the intimate effects. Experiment constantly, and you'll be well rewarded.

Most of your scenes will employ only one or two characters. This means you will cover a small area with your camera, therefore require even less lighting than I have described. The dinky, with its 150-watt lamp, is the largest you'll need. Ingeniously placed, inexpensive floodlights, peanut tubes clipped to lamp shades, even 50-watt house lamps screwed into reflectors, will enable you to build photographically dramatic arrangements. But control your light. Don't let it spill over into the shadows. That's the whole trick. There isn't any more.

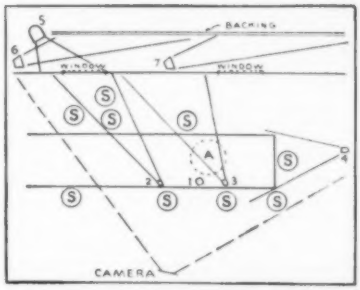
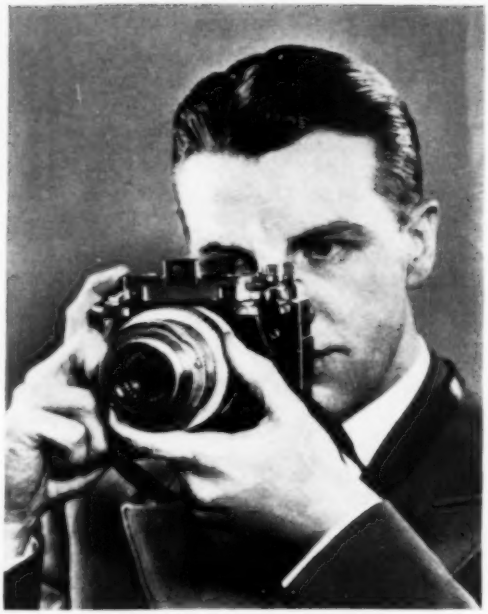


Fig. 4. The main light comes from a No. 2 photoflood inside the lamp shade (A), reënforced by a "dinky." Two other "dinkies" are on the table; another is at far right; and three more lamps provide light outside the windows

FOR CAMERA USERS

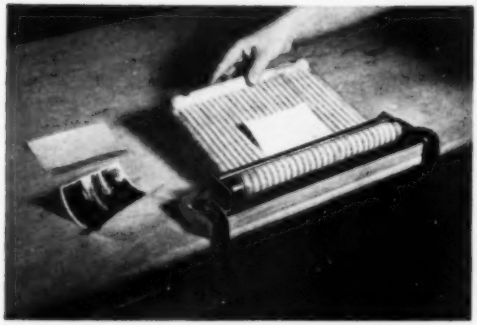


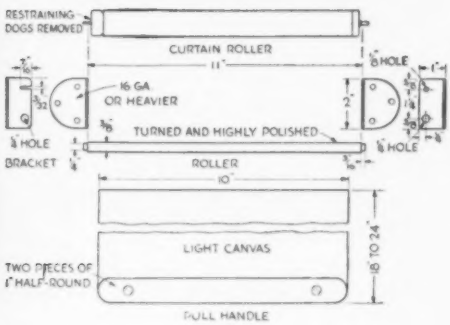
A NEW 2¼" BY 3¼" CAMERA, the Kodak Medalist, combines the convenience of roll film and the advantages of cut film, film packs, and plates, which are used with an accessory back. It has the scope, accuracy, and operating refinements of a precision miniature. The lens is a coated 100-mm., f/2.5 Kodak Ektar, said to be the finest lens ever available in the 2¼" by 3¼" field. Its formula is a new one. The shutter is a special model Kodak Supermatic No. 2, with nine speeds from 1 to 1/400 second at apertures of f/3.5 to f/32.

AUTOMATIC FILM SPLICER. Simple and rapid in operation, there is a new splicer now on the market for joining 8-mm., 9½-mm., or 16-mm. film. The cutting leaves are designed precisely in order to avoid any overlapping or separation of emulsion and the resulting white or black lines. A double-edged file of hardened steel for scraping the emulsion is accelerated in action by means of a spring on its spindle. Grooves in the cutting leaves catch surplus cement and keep it from running down the film. This is a particularly important feature in preventing damage when handling Kodachromes. The splicer is made of chrome-plated steel throughout, and is mounted on a skidproof and warp-proof ebony-finished wood base. The original design came from Switzerland for production in this country.

DARKROOM VENTILATORS of a reduced size for use in home or small commercial studios have been made available. The unit is composed of a standard, self-cooled motor propeller fan mounted in a steel panel, a baffle or hood designed to prevent the introduction of light without restricting air flow, and a fan guard. It will change the air in the room approximately every two minutes, exhausting dampness and odors along with the old air. The motor is of the type that is said to "breathe," a feature that keeps it from gumming up in contact with foul air. Operation is on ordinary house current by means of a common cord and plug. It is said the device takes no more current than an average light bulb.

Adjustable Print Straightener Utilizes a Shade Roller





Above, the parts. Left, the angle at which the belt is held governs the amount of reverse curl

AN ORDINARY window-shade roller is the basis of the adjustable photographic print straightener illustrated. Other parts needed are a polished metal roller, a strip of canvas, and two metal brackets.

The shade roller is a short standard one with a spring about 8" long. Pull out the round pin at one end, remove the cap, and saw the roller to fit between brackets 11" apart. Replace the cap and drive in the pin. Then uncrimp the cap at the spring end, remove the ratchet dogs, replace the spring assembly, and recrimp the cap.

Turn the metal roller as indicated, and polish it. Shape and bend 16-gauge metal brackets as shown, and mount on a narrow wooden base, with the metal roller between.

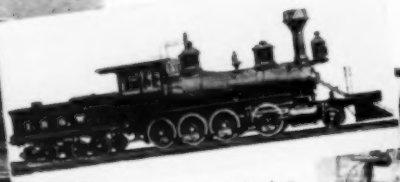
Light canvas or any other heavy, non-stretching cloth may be used for the feeder belt. Cut the material ½" narrower than the shade roller and about 20" long. It is attached with small tacks or a strip of adhesive tape. The wooden roller is then inserted in the brackets, and the free end of the feeder belt is slipped underneath the polished roller so that the handle may be attached. This consists of two lengths of half-round molding, screwed and glued on opposite sides of the belt. The roller spring is next wound up firmly with pliers.

To use the machine, withdraw the canvas feeder belt to its full extension and insert the prints one at a time, face down. These are drawn underneath the polished roller, which gives them a slight reverse curl. Withdraw the belt at different angles for varying degrees of reverse curl. Pull the handle straight up for double-weight or badly curled prints, and straight out for slightly curled prints and those on lighter paper.—SOUTHARD BURDSAL.

Unusual Titles Filmed Through Fluted Glass

BY PHOTOGRAPHING home movie titles through a sheet of ribbed architectural glass, Clarence N. Aldrich, of Long Beach, Calif., obtains a variety of unusual effects. To fade in a title, for example, the glass is first held near the camera lens, then lowered to within 6" of the lettering, and finally moved out and away. To fade out, the process is reversed. The flutings of the glass, when held parallel to the lettering, permit the title to appear sharp and clear, but any movement of the glass causes the lettering to undergo a curious sequence of distortion. In this work, Aldrich uses a vertical titler in outdoor light.

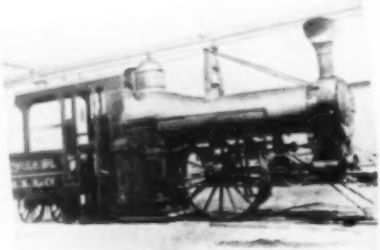
New Utrecht, No. 15, was once used in Brooklyn, N. Y.



Indiana, Bloomington and Western engine

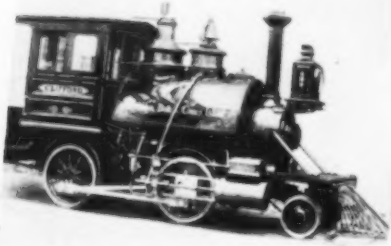
Old inspection engine, Ontario, N. Y. C. & H. R.

Mohawk, N. Y. C. & H. R.



Boynton Bicycle No. 1 Monorail built in 1887

Brooklyn, Bath & Coney



Joseph Lavelle among his photographic treasures

Freak driver on Fontaine No. 1, 1880, didn't work

Mogul—N. Y. C. & H. R.

No. 999—famous locomotive of the Empire State Express

Susquehanna's No. 4 with cab at center of boiler

Locomotive Photographer

Joseph Lavelle has 37,000 railroad-engine pictures in his collection . . . took 22,000 of them himself

By JOHN H. WALKER

JOSEPH LAVELLE is a round, beaming little man of 51 years. He is a diligent amateur photographer and lives near the world's largest airport. There is no hour of the day that does not bring to his house the deep drumming of mighty engines as the big transports glide in toward their landings or climb majestically to the western airlanes. Yet he would no more think of taking a picture of a plane than he would of swimming the Atlantic. For Mr. Lavelle has devoted a good part of his life to a highly specialized hobby. As a photographer and a collector, he is interested in one subject and one alone: Railroad locomotives.

At present he has slightly more than 37,000 photographs of locomotives. No other private collection even approaches his in scope, although the cult of railroad fanciers is by no means a small one.

Mr. Lavelle took about 22,000 of these pictures himself, all on post-card size negatives. The rest are older photographs which he bought, found, salvaged, or copied. The entire collection is filed and card-indexed with scrupulous care, the negatives in light-tight envelopes, the prints in albums arranged by railroads, types, and years.

You might assume that a man so fascinated by the iron horse must have been a railroader all his life. And you would be totally wrong. Joseph Lavelle has never worked a day for any railroad. An injury in early childhood impaired the sight of one eye, and this handicap made it impossible for him to get the kind of operations job he would have liked.

He has sold hardware during most of his working career, and has been with his present firm in New York for 18 years.

He was interested in railroads as soon as he was old enough to know about them, however, and so were all the members of his family. For one thing, their house out in the Queens residential section of New York City (not far from La Guardia Airport) used to be right next to one line of the Long Island Railroad. The district has been built up for homes and its nature has changed completely, but Mr. Lavelle is still living on the same corner after 48 years. That's almost unheard of in New York, but he just likes it there.

"Here's how I got started," he says. "Years ago, when I was just a little kid, my uncle used to take me into town to the Grand Central Terminal. It was all open then. The roundhouse was near-by. The steam locomotives came right into town. You could see everything. I still remember them—compound ten-wheelers.

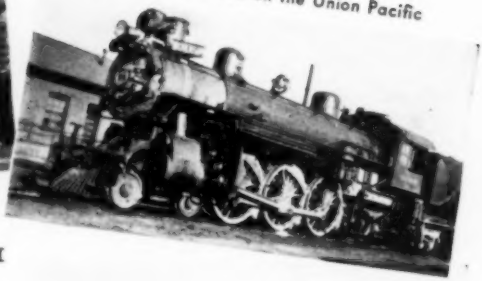
"Well, I got the habit of jotting down the number of every engine I saw there, and when I saw one again I'd put a dash after it every time. After a while I thought to myself, why not take a camera along? So I did. And I've never stopped making pictures of them."

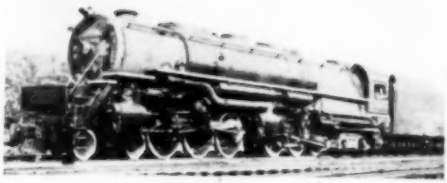
His first camera was a primitive box model. He has had several others since then, but they all had one thing in common—they gave him a good-sized negative. He has never learned to like the miniature camera.

"I don't see much point in taking a small picture and going through the process of blowing it up when you can get a good-sized

New type Delaware & Hudson No. 1510

Modern No. 3216 on the Union Pacific





No. 1504 of the Delaware & Hudson

negative to start with. For locomotives I like the post-card size."

Mr. Lavelle has never bothered with gadgets. He uses an old model roll-film camera which he picked up secondhand several years ago. It replaced a similar but much older box, and has a better lens—a Goerz Dagor, 6½" focal length, speed f/6.8.

All his equipment is characterized by the same simple, no-nonsense quality. When he began expanding his collection by borrowing and copying rare photos of engines, he realized he would need a copying camera. He didn't want to spend much money for it, so he decided to try an experiment and make his own out of cardboard cartons, black paper, and glue.

It functioned perfectly for several years and copied some 1,800 pictures for him. Mr. Lavelle scrapped it two years ago in favor of a newer model, this time made from an old view camera which he had picked up cheap. He designed and made a set of wooden tracks for the box to move in, to simplify focusing.

Mr. Lavelle's approach to photography is very frankly that of a collector rather than a creative worker. The camera is simply a recording instrument; what he wants are clear, honest record prints of his locomotives. His standard way of taking the shots is either directly broadside to the engine, or from an angle which gives him a three-quarters profile.

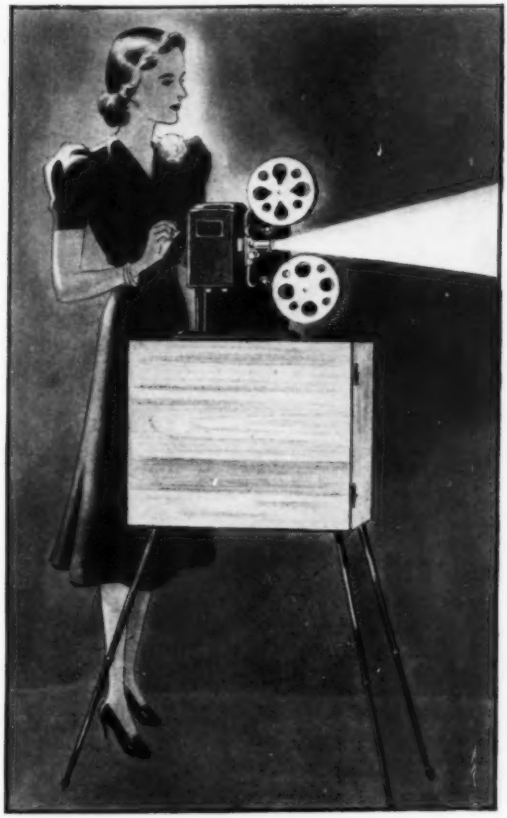
That position is the best to show the details of the engine's design, especially the number and arrangement of the drivers and wheels. Mr. Lavelle has almost no action pictures in his files, and he never makes any conscious effort to dramatize or glamorize his subjects. He would consider this undignified and unscientific. The qualities of power, humor, quaintness that appear in his pictures are inherent in the locomotives themselves.

Among the older and more unusual of his pictures are some that he has dug up from out-of-the-way sources and copied. For instance, there is a monorail locomotive called "the Boynton Bicycle." "Very little is known about it," says Mr. Lavelle, "except that it was built by the Portland Company in 1887." The drivers of another freak were thrust up at an angle to a kind of overhead flywheel which drove the lower main wheels. It was built by the Grant Locomotive Works in 1880 and wasn't successful.

Mr. Lavelle is not taking so many pictures lately. He keeps up with the new streamlined locomotives, because many of them are old friends unchanged mechanically, with fancy stainless steel coats plastered over their honest boilers and steampipes. He takes the pictures for the record, but the new types leave him cold. They just don't look like locomotives.

Another problem he has run into is that of the national defense emergency, which has led to a vast tightening up of restrictions around yards, shops, and factories. The day when an earnest amateur could prowl at will with a camera in those precincts is definitely past. He had planned a vacation trip out to the Middle West and back through the South, taking pictures all the way, but gave it up after seeing the red tape he would have to buck.

For the present he will concentrate on his files, going over them and reorganizing some parts. He'll also be able to give more time to a side-line collection of books, manuals, pamphlets, and other printed matter relating to railroads, which grew up more or less by itself. He estimates there are about 400 of these items altogether.



Stand and Carrying Case for Movie Projector

By L. C. PELTIER

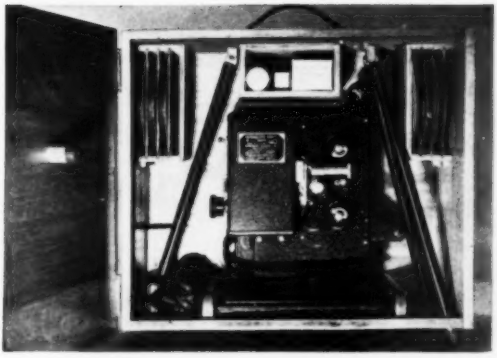
IN SHOWING home movies or slides, one of the prime essentials is a table or stand of appropriate height for holding the projector. Usually a card table is set up, or a table from the living room is cleared off and pressed into service. Better than either is a combined case and stand of the type illustrated.

In this instance ½" maple was used for constructing the case, though plywood or leather substitute on a wooden frame could be used quite as well. Three holes were drilled at the correct angle in the bottom of the case to hold the lower ends of the telescopic metal legs from a discarded camera tripod. The upper ends of the legs were secured to the case top with small metal angles. When the tripod legs are fully collapsed, the rubber-tipped ends project through the case bottom sufficiently to form feet.

Convenient racks for holding extra reels of film are built into the upper corners of the case. Above the projector is another shelf for holding a splicing outfit, extra bulb, and other accessories. In the lower corners there is room for extension cords and attachments. The strap handle is slotted so that it will flatten out when the projector is placed on top.

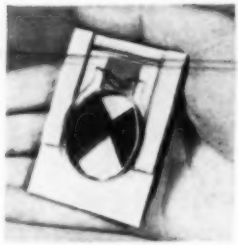
The case can be set up instantly for use as a stand by pulling out the rubber-tipped legs to the correct extension. The projector is then taken out and placed in operating position on top.

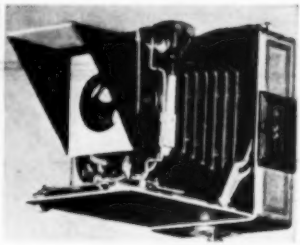
The dimensions for the construction of the case will vary with each type of projector, but they can be worked out easily by the craftsman.

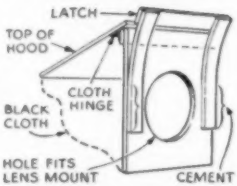


Homemade Folding Lens Shade Fits into a Cigarette Case

TRIANGULAR sections of black cloth fastened with rubber cement as shown to a frame of stout cardboard, such as heavy photo-mounting board, form a compact, inexpensive folding hood for a camera. To determine the size, make an experimental hood of black paper and fit it over the lens after focusing a scene on the ground glass. The hood must, of course, not obliterate any part of the image. To make this test on roll-film cameras, tape a piece of tissue paper over the film track. When cutting the flexible cardboard strips, be sure the grain of the material runs lengthwise for strength.—ROBERT SCOTT.





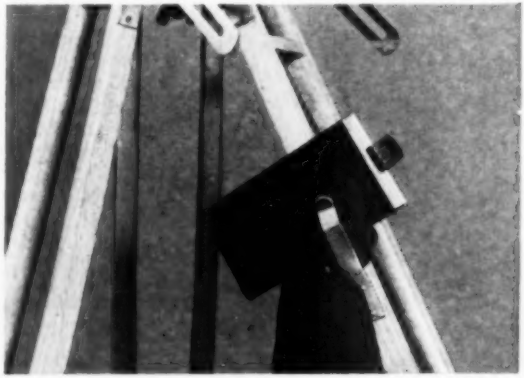


A wire clip attached by cementing heavy paper over part of it holds the hood on the lens

Although shown unpainted for clearness, the hood should be finished a dull black all over

Spring Clip on Tripod Holds Accessories

A SPRING clip screwed to one leg of a wooden tripod, or fitted to a tubular metal tripod like a large pencil clip, is a handy gadget for the photographer. It provides a place for the dark slide, or for any other lightweight accessory, such as the focusing cloth, and thus prevents such articles from being mislaid or dropped on the floor. The clip should not be attached where it interferes with the closing of the tripod.—R. O. LISSAMAN.



Adapting an Old Synchronizer Unit for Multiple-Flash Work

MULTIPLE-FLASH photography requiring extension sockets and an additional battery cell can be done with ordinary synchronized-flash equipment altered as shown. Cut off the threaded end of an old flash-light case and solder it to the synchro-flash battery case to provide space for the extra cell. The regular threaded cap will fit this piece. A 10-cent plug having a socket and two prong outlets completes the assembly.—K. M.

Screw the shell from an old lamp socket over the base of the plug for a good fit in the quick-change socket. At right, the complete equipment

Snapshots the Fall and Winter sport of millions

OUTDOORS

Use Kodak Verichrome Film for your outdoor pictures this fall. Bringing extra assistance, it makes the average camera a better camera—helps overcome small exposure errors, extends the "snapshot day," lets you get swell snapshots even when the day is dull. Load up now with Kodak Verichrome Film.

FALL days are full of pictures . . . harvest scenes, hunting and hiking and football shots . . . And when evening comes, the cozy, brightly lighted world indoors yields particularly precious family snapshots.

Will you get really good snapshots this time of year? Yes; not a doubt of it. Last fall and winter, average picture takers made millions of successful snaps. So be sure to get your share . . . Eastman Kodak Company, Rochester, N. Y.

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Super-fast Kodak Super-XX is the film for indoors at night. You use it with Photoflood bulbs and inexpensive cardboard reflectors for snapshots at night. A fascinating new sport for your camera.

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DELAY is costly when your car begins to use too much oil. Oil-pumping is the warning that all is not well within your motor. Usually it means rapid cylinder wear has started . . . and that can be much more expensive than buying extra oil. At the first sign of oil-pumping in your car, truck or tractor, install Hastings Steel-Vent Piston Rings.

Note to Used Car Buyers: Ask the dealer if it's Steel-Vent Reconditioned. It's a better buy if it is.

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GENTLE on Cylinder Walls

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STEEL-VENT PISTON RINGS

Stop Oil-Pumping

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Gus Talks Tire Turkey

(Continued from page 144)

Then put your spare tire on the right rear."

A car stopped outside the shop door, and half a minute later Henry Miller came in, looking worried. "Say, Gus, the missus tells me that you say there's something wrong with our front-end again. You fixed that up not so long ago. Wouldn't a new set of tires do for now?"

"I'm sorry, Henry, but it wouldn't," Gus said. "I don't know just what's the matter with your front end, but I can tell from the way your tires have worn that it's out of alignment somewhere. Putting new tires on without straightening it would just be wasting good money—and good rubber."

"All right," Miller said. "You're the doctor, Gus. Got time to take a look tonight?"

"Sure thing," Gus said. "Bring your bus in and I'll check it.

Miller drove his car into the shop. The first thing that Gus did was reach in and try the steering wheel. "Too loose," he said, making a note on his order pad. "That's bad for your tires. Now let's check 'em."

He checked the tires. Each showed a different pressure, and only one of the four showed the correct pressure. Gus shook his head sadly. "You ought to try to get Mrs. Miller to stop in here once a week and have her tires checked," he said. "They'd last a lot longer if she would."

He inflated the tires to their proper pressure. Then he had Miller run the car onto the wheel-alignment rack, and made a lot more notes on his order pad. Then he compared his notes with a table of figures in a book he brought over from his workbench.

"Some one must have given your front-end a hard bump while you were parked," he told Henry diplomatically. "All the steering angles are off. To get good service out of these modern cars you've got to have the caster and camber and toe-in in exact agreement with the manufacturer's specifications. . . . Knee action is O.K. . . . Kingpins are loose." He checked the brakes. "Here's a broken brake-shoe return spring," he reported. "That makes the shoe drag, and plays the devil with the tire. . . . There's oil leaking from the rear-end, Henry—a gasket must have gone bad. Your left rear tire is oil soaked—there must be a puddle from the leak on your garage floor. Oil's very tough on rubber, you know, and ruins brake linings. . . . Well, I guess that's all, Henry. Bring your bus around as soon as you can, and I'll fix it up."

"I'll leave it here now," Henry said. "And I'm going to tell the missus plenty about the way she's got to treat those new tires!"

AT 60 miles an hour, the ignition coil and distributor in a modern car produce and deliver "lightning" at a speed that makes machine-gun fire slow by comparison. *200 times a second* these units take the six volts from the battery, build it up to as much as 18,000 volts, and deliver it to the correct spark plug. No less remarkable is the fact that each high-voltage impulse is timed to within 1/10,000 of a second.

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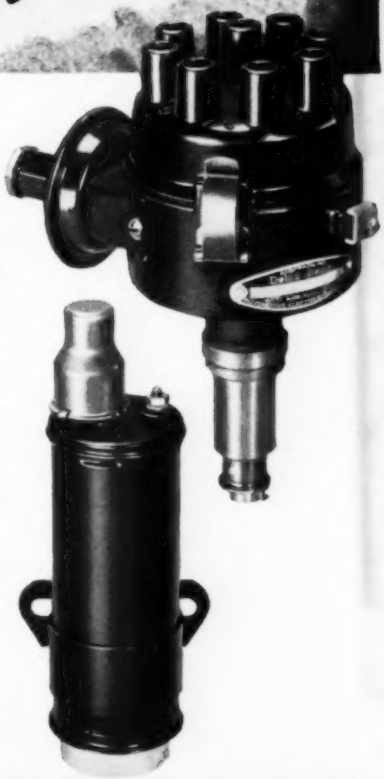

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ORIGINAL PARTS ASSURE "LIKE-NEW" PERFORMANCE

War in the Stratosphere

(Continued from page 109)

available at the gunners' battle stations."

The airplane's fuselage should be circular rather than of oval or elliptical cross section, because a tube under internal pressure always forms a circle, pressure being equal at all points. The hump formed by the pilot's cockpit is reduced, or completely eliminated. Fortunately, the designers found that dural heavy enough for the skin of a big bomber was also sufficiently strong, when properly stressed, to withstand the internal pressure at high altitudes. Windows are of Plexiglas, chosen in preference to glass because of its high strength-weight ratio.

This pressure is obtained through supercharging. Air is drawn from a duct in the leading edge of the bomber's wing. From here it passes through a water separator, through two large superchargers driven by the ship's inboard motors, through a steam radiator in the wing, through the intercooler to reduce the temperature of the air, through the inflow regulator, on through the cabin, out through the floor, then through the outflow valve which is a part of the same unit with the inflow regulator. A flight engineer controls the supercharging from a special panel behind the pilot's station.

Getting the interceptor and its pilot up to meet these substratosphere bombers involves even more ironing. Like the bomber, the interceptor must be fitted with high-powered engines whose power is kept high by the use of both centrifugal and turbo-superchargers, constant-speed propellers, automatic mixture controls, etc. There are, so far as is known, no pressurized pursuit planes or interceptors. The reasons: The cockpits are, of necessity, irregular in shape and they are small. Even if they could be shaped so as to take pressurizing, the ship's supercharging equipment would weigh so much that some of its performance would be sacrificed. The only immediate solution seems to be the use of pressurized suits of the Wiley Post variety.

Present suits are electrified to provide warmth for pursuit pilots and bomber crews, and the novel feature of these is the "electric underwear." This is a heavy woolen union suit into which wires are sewn in parallel waves—to give an accordion effect to permit stretching and body movement—for heating. This unit is covered by an outer shell of heavy gabardine, and heated boots and gloves complete the outfit. The

(Continued on page 222)

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War in the Stratosphere

(Continued from page 220)

heater control insures comfort through a range of temperatures from 70 above to 60 below zero. These suits are many pounds lighter than the heavy leather and sheepskin-lined garments formerly used by the Army and Navy aviators. Cockpit heaters are also used to keep the fighter pilot's office warm. Plane performance and bodily comfort are only a part of the flyer's worries, however. There are operational problems at these high altitudes which call for a very special kind of flying technique. He must watch himself at every turn, both literally and figuratively.

A steep turn at 30,000 feet, if not properly executed, may cost the interceptor pilot his life. It's all a matter of G load factors and wing loading. The air is one third the density of that near the ground, and the plane's power plant—engine and propeller —is at its maximum power output to keep the "thrust" normal. The sea-level stalling-landing speed of his ship is, say, 75 miles per hour, with the wing flaps down. With flaps up, it is 95 m.p.h. POPULAR SCIENCE readers know about the manner in which G's build up in a pull-out from a dive. A Bell Airacobra interceptor weighs 6,662 pounds and is subjected to the force of 1 G in level flight in smooth air. Deviation from this straight, level course results in a higher load factor acting upon the wings—the number of G's depending upon the speed and sharpness of the maneuver. Speaking aerodynamically, a vertical or near-vertical turn is a lateral pull-out, and in the upper half of a loop the plane describes an upward pull-out. A 3-G acceleration in any direction imposes a 19,986-pound load on the Airacobra's wings. Therefore, the stalling speed is increased about 55 percent. We are talking in terms of low-altitude performance. Up in the substratosphere, the stalling speed is proportionately higher because of the rarefied air. A steep, high-speed turn causes the ship to "mush," or skid and this sliding often slows speed to the stalling point, which at these altitudes can be as much as 70 percent higher than normal because of the imposed G-load factor and the high wing loading inherent in any high-performance interceptor.

Not only will the ship stall and spin out of a too-tight turn, but it will fall out of control several thousand feet before the air becomes dense enough for the controls to gain a grip and right the plane! During this time, of course, the interceptor pilot is cold

(Continued on page 224)

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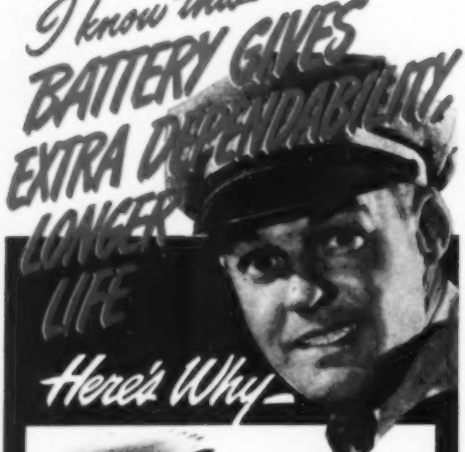

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War in the Stratosphere

(Continued from page 222)

meat for the enemy fighter who follows him down.

Altitude fighting is mostly a hit-and-run affair because of the impossibility of close-in fighting and rapid maneuvering. The pilot lines up the bomber or enemy fighter in his reflector sight, fires away, then pulls away—gently. There is not only the danger of stalling, but also the danger of "blacking out." Medicos believe that this occurs more readily at high altitudes.

If, for any of a number of reasons, the interceptor pilot or members of the bomber crew are forced to bail out of their high-flying craft, they must carry oxygen with them or perish. This is not difficult. The rubber supply tube is disconnected from the plane's tank and attached to a small flask in the flying suit. Sans oxygen, one would have to drop from 35,000 feet to 20,000 feet in just one and one half minutes if one were to remain conscious. He could fall free within this time, but anoxemia suffered during even this short interval might affect him so as to make thinking cloudy. He could, conceivably, forget to pull the 'chute ripcord. On the other hand, if he bailed out at 35,000 feet and opened his 'chute immediately, about ten minutes would be required to float down to 20,000 feet. He would never reach earth alive.

The solution to these problems and others is being sought by the Air Corps' aviation-medicine staff at the Wright Field Physiological Research Laboratory, working in conjunction with the Mayo Clinic. Among the noted researchers are Capt. Otis D. Benson, Dr. W. Randolph Lovelace, Dr. Walter M. Boothby—coinventors of the BLB "oronasal" oxy mask which won them last year's Collier Trophy—Capt. Harry G. Armstrong, Dr. John W. Heim, and Dr. Arnold D. Tuttle. The stratosphere keeps its secrets well, but there is much that, of necessity, must be learned if our bombers are to fly much higher and our interceptors are to be able to keep their present tactical advantages over hostile bombers.

Question Bee Answers—Page 128

1. Read
2. Lindbergh
3. Musick
4. Corrigan
5. Hawks
6. Hughes
7. Curtiss
8. Rodgers
9. Rickenbacker
10. Wright brothers
11. Post
12. Amelia E. Putnam
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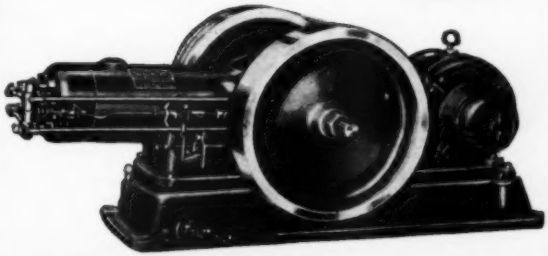

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Full-Color Prints Now Made from Film Transparencies

PHOTOGRAPHIC prints in full color, prepared by some direct, simplified process, have been the dream of thousands of amateurs since 1936, when the introduction of Kodachrome film in miniature sizes made color photography almost as easy to the camera addict as taking snapshots in black and white. Color prints that preserve accurately the hues of the original transparencies have also been the need of many professionals. By means of a drastically new process of printing, perfected by the makers of Kodachrome, such prints are now available.

Minicolor prints, as the amateur sizes are called, are enlarged from either 35 mm. or bantam size Kodachrome transparencies by a standardized process, evidently resembling to large extent in its technical manipulation the Kodachrome process itself. They are made only from Kodachromes in 2" by 2" mounts, with standard central openings, and are available in two sizes. The so-called "2X" size is about $2\frac{1}{4}$" by $3\frac{1}{4}$", and the "5X" size about 5" by $7\frac{1}{2}$". The "feel" of a Minicolor print, especially in the smaller size, is that of a fine playing card. The base is of cellulose acetate colored with white pigment.

It is not suggested that the new prints will supplant the projected Kodachrome transparencies, but they bridge a gap which neither the tiny film nor its projection on a screen could fill. The smaller size makes an attractive miniature for use in a desk frame. It may be mounted on personal Christmas or greeting cards, or a special Minicolor section may be created in the photographic album. The larger prints are returned mounted and, when framed, make attractive decorations for the home.

Color prints for the professional are called Kotavachrome and differ from the amateur prints only in the fact that they may be made from professional Kodachrome transparencies up to 8" by 10" in size. Prints may be had as large as 30" by 40". They make excellent material for sales portfolios, sample books of architects and interior decorators, advertising illustrations, exhibits, home murals, and other uses where full color can present a subject more attractively.

Both Minicolor and Kotavachrome are made with dyes which are as stable as it is possible to make to meet the requirements, but exposure to intense sunlight should be avoided. With reasonable care, it is believed that they will keep their color and brilliance indefinitely.

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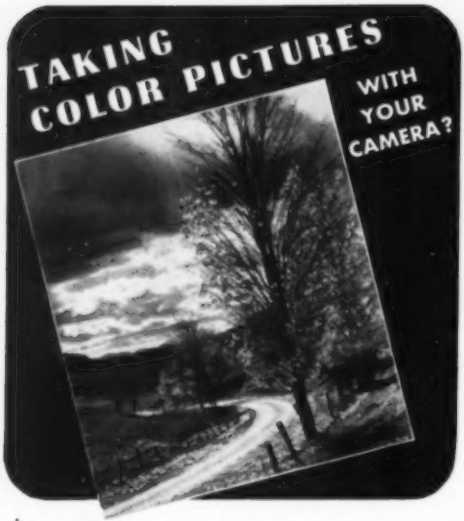

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Our Plans Make It Easy to Build a Workbench

ARE you planning to improve your home workshop for more enjoyment during the winter evenings ahead? Why not start by constructing the sturdy POPULAR SCIENCE workbench shown above? Simple bolted construction makes it easy to build, hard to overload. Knee space under part of the top allows you to sit while working. Other features of this compact 24" by 58" design are: plenty of roomy drawers, a useful stop that takes the place of an end vise, and built-in rollers on which the bench may be moved. Blueprint No. 405 (25 cents) gives all construction details and a list of materials.

A partial list of our other blueprints follows. For a complete list, send a stamped, self-addressed envelope.

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Clipper Ship SOVEREIGN OF THE SEAS, 20½" hull, 51-52-53-R..... $1.00
Cody Coach, 13" long, 144-145-146-R 1.00
CONSTITUTION ("Old Ironsides"), 21" hull, 57-58-59-R 1.00
Covered Wagon, 23½" long, 118-119-120-R..... 1.00
Cruiser U.S.S. INDIANAPOLIS, 12" long, 216..... .25
Elizabethan Galleon REVENGE, 21" hull, 30" long, 25" high over all, 206-207-208-209..... 1.00
New Bedford Whaleboat, with complete equipment, 14" long, 326-R..... .50

(Continued on page 230)

New Issue of 1940 Index

BECAUSE of an unprecedented demand for the 1940 Home Workshop Index, our original supply was exhausted, and we were obliged to order a second printing. If you were unable to obtain your copy, it would be advisable to order it now. No coupon or letter is necessary. Simply address Popular Science Home Workshop Index, 353 Fourth Avenue, New York, inclosing 10 cents together with a legal-size (No. 10) stamped envelope addressed to yourself.

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make good mechanics *better*
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Blueprints for the Shop

(Continued from page 229)

Privateer SWALLOW, a Baltimore Clipper, 13" hull, 228-229-230-R 1.00
Racing Yacht, 20" Marconi-rigged sailing model, 48-R ..... .50
Spanish Treasure Galleon, 24" long, 46-47 ..... .50
Trading Schooner, 17½" hull, 252-253 ..... .50
U. S. Battleship TEXAS, 3' hull, 197-198-199-200 .. 1.00

MISCELLANEOUS

Bird and Animal Patterns, 56 ..... .25
Bronze Hammer, Rolled-Edge Metal Tray, Table Centerpiece for Easter (rabbit hitched to wagon), 407A .25
Five-Piece Desk Ensemble (letter rack, blotter, letter opener, etc.), Nautical Lamp (resembles engine-room telegraph), 410A ..... .25
Folding Wall Brackets (turned), Treble-Clef Bud Vase (metal or plastic), Vacuum Cleaner Attachment Rack, 408A ..... .25
Outdoorsman's Lightweight Trailer, 10' long, 4' wide, 4' 9" high, kitchenette on back, 300-301-R ..... .75
Turned Costume Jewelry and Solid Model of Argonaut Pirate Flying Boat, 275A ..... .25
Turned Table Lamp, Deringer Pistol, and Weather Vane (woman watering garden), 406A ..... .25
Workbench for Home Shop, 24" by 58" by 34¼" high, 405 ..... .25

FURNITURE

Colonial Writing Desk, 3' 6" high and 3' 8" long, 21 ..... .25
Combination Bench and Tilt-Top Table, (no turning), 11 ..... .25
Early American Style End Table, 361A ..... .25
Fireplace Screen (brass and wrought iron), Bedside Cabinet, and Trinket Box, 389A ..... .25
Gate-Leg Table, 3' 6" diameter, circular top with leaves up (no turning), 24 ..... .25
Modernistic Folding Screens, 4 designs that require no turning, 91 ..... .25
Smoking Cabinet, 2' 4" high, 2 ..... .25
Tavern Table and Scroll Mirror, 105 ..... .25
Telephone Table and stool, 18 ..... .25

BOATS

Cabin Cruiser, 17' long, weighs 750 lb., may be used with 2 to 10 h.p. outboard or inboard motors, 356-357-358-359-R 1.50
Camper's Utility Boat, 11' 2" long, canvas-covered, for outboard motor or rowing, 281-R ..... .50
Cruising Sailboat, 19' long, weighs 700 lb., Marconi sloop rig; can be used with 1 to 4 h.p. inboard or outboard motor, 400-401-402-403-404-R 2.00
High-Speed Boat for Small Outboard Motors, 7' 11" long, 257-R ..... .50
Plywood Dinghy, 9' 7" long, weighs 60 to 75 lb., can be rowed, sailed, or used with small outboard motor, 387-388-R ..... .75
Sectional Rowboat, 9' 8" long, two sections, weighs 60 lb., all-wood construction; can be used with small outboard motor, 340-341-R ..... .75
Sport Runabout, 9' 8" long, for small outboard motor, weighs 100 lb., 309-310-R ..... .75
Utility Rowboat, 13' long; can also be sailed or driven by outboard motor, 224-R ..... .50

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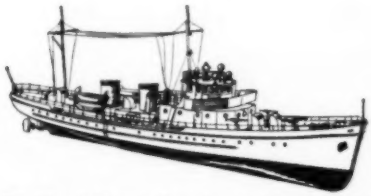
Typical of the more elaborate models is that of the Coast Guard Patrol boat *Atlanta*, shown below. This is 20⅝" long, scaled ⅛" to 1'. Kit 5S includes anchors, propellers, ventilators, mooring bits, life rings, flags, a bell, and a brass ladder, and is priced, with the blueprint, at $5.40.

Also available are kits for whittling a sea captain and six Scotties, and for constructing miniature Colonial rooms. A price list of all our kits will be sent upon receipt of a self-addressed, stamped envelope. Address POPULAR SCIENCE MONTHLY, Dept. 111, 353 Fourth Avenue, New York.



Kit 5S—A Coast Guard patrol-boat model

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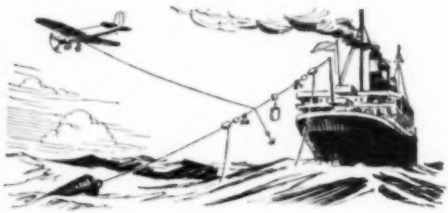

extending the successful service to sea. To pick up mail from a ship, his plan calls for trailing a sea anchor on a cable from a mast astern. Air mail would be swung on a section of this cable, equipped with retaining checks and breakable links at each end. By lowering a hook as illustrated, a plane would snap off and haul aloft the breakable section and its burden of mail without stopping. Meanwhile, loss of the ship's sea anchor would be prevented by an auxiliary cable by-passing the detachable part. Deliveries to a ship could be made by lowering the mail, on a breakable section of weighted line, to a similarly trailed cable around which it would become entangled. With a pair of cables secured to different masts of the ship, pick-ups and deliveries could be made simultaneously. . . . IT'S NO INCONVENIENCE to have a heavy crate or ingot slip from your fingers, and light on your toe—provided you happen to be wearing a pair of foot and ankle guards designed by D. Cataffo, of Mullens, W. Va. The strong steel protector transmits the force of the impact directly to the floor. Completely clearing the wearer's shoe, the guard turns under beneath its sole, where it is attached with screws, as shown in the accompanying sectional drawing. An upward

(Continued on page 235)

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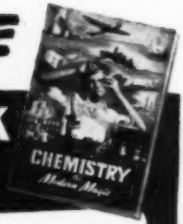

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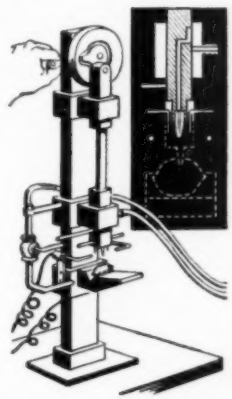
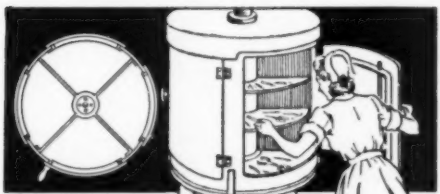
With the Inventors

(Continued from page 232)

extension saves barking the shins against machinery or piping. . . . EXPLODING THE SHELLS of pecans and other nuts, instead of crushing them, is proposed in a series of patents recently assigned to the University of California. High-speed machinery takes the place of hand labor to extract the nut meats with a minimum of damage. In the electric method illustrated, a hollow needle punctures the nut shell and injects an explosive gas mixture such as hydrogen and oxygen. Simultaneously, the shell is pierced by a pair of sharp-pointed electrodes, and a spark sets off the gas. An alternative scheme dispenses with electricity, blowing up the nut with air or carbon dioxide gas at a pressure of 200 pounds to the square inch. . . . ANTISEPTIC VAPOR takes the place of steam in a novel sterilizing cabinet for surgical or dental instruments, designed by Charles Dupuy of Brooklyn, N. Y. In consequence, he declares, keen blades may be sterilized up to 50 times without injury to the cutting edge; while tests have shown the vapor treatment capable of killing anthrax spores in only 15 minutes. An inner, rotating drum is divided into four radial compartments. Only one compartment can be opened at a time, for withdrawal of instruments on its shelves. These are replaced with instruments to be





sterilized, the vapor-tight door is closed, and the drum is rotated to the next position. This arrangement, which includes seals between the compartments, assures that the

(Continued on page 236)

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SEE PAGE 48

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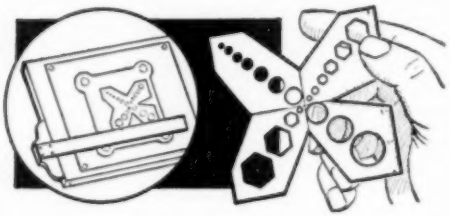
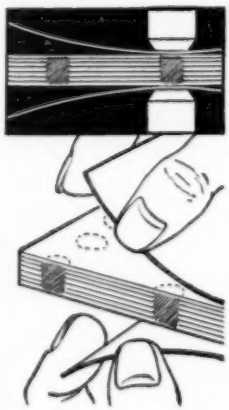
With the Inventors

(Continued from page 235)

one opened will have undergone the longest period of sterilization. . . . A COMBINATION GUIDE for mechanical draftsmen facilitates their work especially in drawing screws or screw threads. Made of transparent material and used with a T square, it provides



cut-out portions for angles of 15, 30, 45, 60, 90, and 120 degrees. Holes in the guide simplify drawing hexagonal bolt heads of graduated sizes from ⅛-inch to one-inch size, and circles of similar dimensions. The inventor, Howard A. Dibble, Jr., of Hartford, Conn., points out that any side of the guide may be placed against the T square with complete accuracy of positioning. . . . TO SAFEGUARD DEFENSE INVENTIONS, new teeth have just been added to patent law of the first world war. Since October, 1917, the Commissioner of Patents has been empowered to withhold an applicant's patent for an idea of military value, and order it kept secret, "during a time when the United States is at war." An amendment of July, 1940, made the same procedure applicable, whether the United States was at war or not, for a period of two years. Now, effective since September, 1941, violation of the Commissioner's order of secrecy may result in a $10,000 fine, imprisonment for two years, or both. . . . BETTER WELDS in airplane wings are said to be obtained through a discovery of Lucien F. Argentin of Philadelphia, Pa. When several layers of stainless-steel sheets are to be spot-welded together, he sandwiches the



(Continued on page 239)

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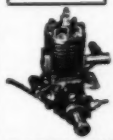

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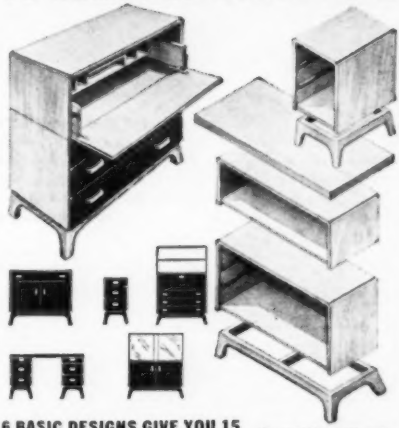

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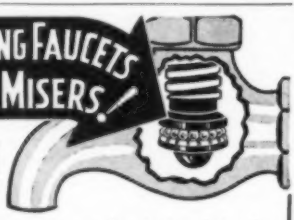

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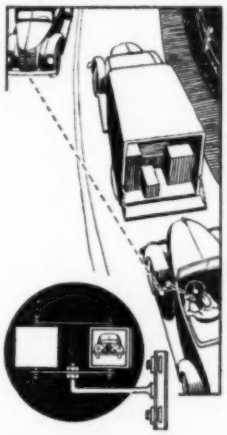
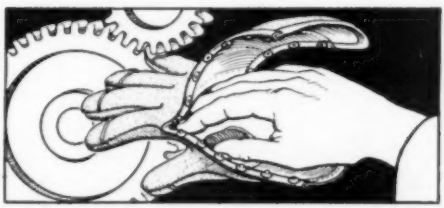
With the Inventors

(Continued from page 236)

stack between two extra sheets of the metal, and peels off the latter after the electrodes have done their work. Tests show that the "nugget" of fused metal extends through the interior of the remaining pile and well into its outermost layers, forming a secure bond. . . . A "FRONT-VIEW MIRROR" provides a new gadget for motorists to attach to their cars. Installed on the left-hand side of an automobile, it serves as a periscope to look past a vehicle directly ahead. Thus a driver can see when a car is coming the other way, and when he can safely swing out and pass. Invented by D. L. Stokesbary, of Ferndale, Wash., the device consists of a pair of adjustable mirrors in a frame, with a clamp that may readily be attached to the front of the door flange. Screws removable only with a special tool make the mirrors practically theftproof. . . . A SAFETY GLOVE that keeps a worker from getting his hands mixed up with machinery has been devised by H. S. Barker, of Maybeury, W. Va. Snap fasteners normally close the part of the glove that encircles the hand and wrist. But if a careless machine operator gets his fingers caught, as in the illustrated gearing, the fasteners part and allow the glove to be ripped off, automatically freeing his hand from being drawn after it. Accord-





ing to the inventor, his idea should help to offset an estimated 20-percent increase in the number of industrial accidents since the defense speed-up, which are due in part to inexperience of new personnel.

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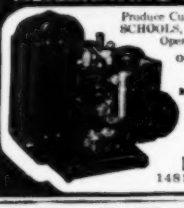

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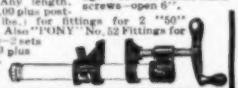

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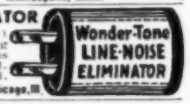

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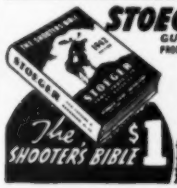

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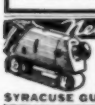

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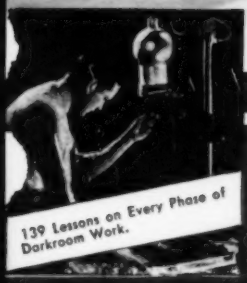

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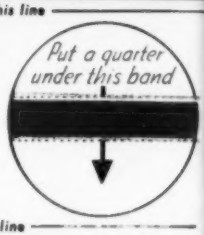

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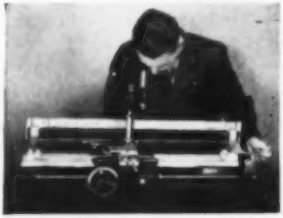

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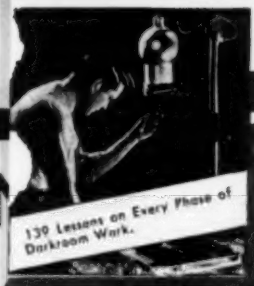

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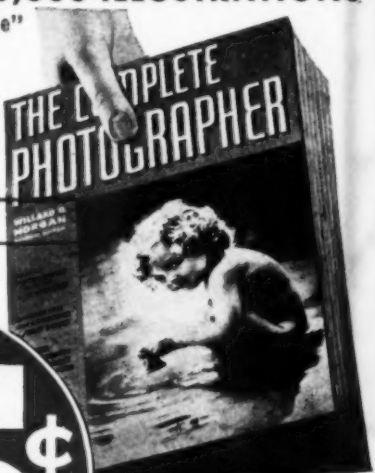

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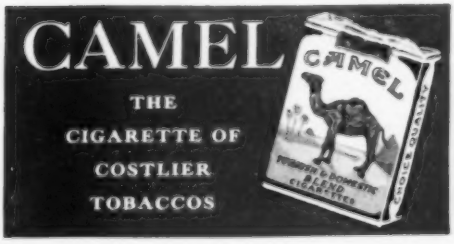

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